



1994

# The Building of Auguste Perret in Alexandria: A Case for Preservation of Modern Egyptian Architecture: Historic Preservation Defined

Alaa Elwi El-Habashi  
*University of Pennsylvania*

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## **Disciplines**

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Historic Preservation Defined

THE BUILDINGS OF AUGUSTE PERRET IN ALEXANDRIA:  
A CASE FOR PRESERVATION OF MODERN EGYPTIAN ARCHITECTURE

Alaa Elwi El-Habashi

A THESIS

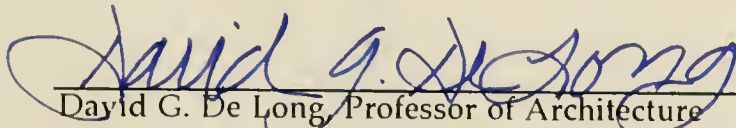
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Historic Preservation

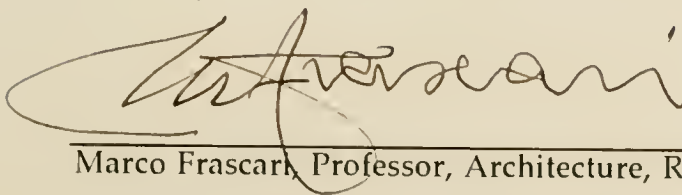
Presented to the faculties of the University of Pennsylvania in  
Partial Fulfillment of the Requirements for the Degree of

MASTER OF SCIENCE

1994



David G. De Long, Professor of Architecture  
Advisor and Graduate Group Chairman



Marco Frascari, Professor, Architecture, Reader

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To my mother and my father



## Acknowledgments

"Praise be to God, Master of the world, the most gracious,  
the most merciful, . . ."

My sincere gratitude to my advisor, mentor and friend: Professor David G. De Long. His courses on history and theory provided me with the intellectual background upon which this thesis was built. I shall acknowledge his interpretation, his generous advice and criticism, and his continuous encouragement during the preparation of this thesis.

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My thanks also to my family for their patience and support during the preparation of the thesis.





## ABSTRACT

### **The Buildings of Auguste Perret in Alexandria: A case study for preservation of modern Egyptian architecture**

**Alaa Elwi El-Habashi**

This thesis is a study of three specific structures designed by Auguste Perret for the nineteenth-century Wabour El Maya district in Alexandria, Egypt. Perret designed several buildings in Egypt. His Egyptian commissions, perhaps with the exception of the 1931-32 Cairene Awad Bey Villa, got little attention from both art historians and from Egyptian authorities. In this study, I will focus on the analysis of Perret's Alexandrine buildings particularly because they are the least covered by the literature. The 1926 Alexandrine Villa Aghion, which was Perret's first commission in Egypt and the first Egyptian residential building to use exposed reinforced concrete, is in fact the only structure among Perret's Alexandrine buildings that historians included in the architect's list of designs. The study then confirms the attribution of these three existent buildings to their French architect.

The thesis is neither a detailed history of the evolution of modern architecture in Egypt nor an affirmation of Auguste Perret's ingenious use of reinforced concrete. Rather, by limiting my study to these three buildings, I will try to define a new profile for Auguste Perret based on his respect for local building traditions. This intellectual profile is also confirmed by the architect's other non-European designs, as in the case of his Algerian, Moroccan, Lebanese, and Tunisian as well as other Egyptian structures. Perret's Alexandrine buildings, hence, affirm that the architect's specialty was not only reinforced concrete, but concrete used with respect for local traditions.

I am inviting Egyptian authorities as well as world preservation organizations to shed light on modern Egyptian monuments which are exemplified in this research on Perret's buildings. It should be realized that Egypt is not only a rich museum of Pharaohs' temples and Arab mosques, but also a place of important modern buildings. The modern livable part of Egyptian history should not be kept in the shade of antiquities.



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## INTRODUCTION

Passing by the nineteenth-century Wabour El Maya district in Alexandria, Egypt, I always admired three buildings. I was told during my education in the architectural department at Alexandria University that one of these buildings (Villa Aghion) was built by the French architect Auguste Perret. No further information was available either on this villa or on the other two buildings. However, I always felt that there was something which related them to each other. It was not until the preparation of a presentation on Auguste Perret that I read the most recent book on Auguste Perret (Fanelli and Gargiani, 1991). Reviewing the list of Perret's buildings at the end of this book, I realized that the three Alexandrine buildings are included. The common factor linking these buildings is then the architect. Surprisingly, Fanelli and Gargiani stated that Perret's Alexandrine designs, with the exception of Villa Aghion, were never executed. Knowing that among Perret's designs these three structures are the least covered by the literature, I decided to devote my thesis research to studying them and confirming their attribution to Auguste Perret. Moreover, the analysis of these buildings as well as Perret's non-European designs allows me to draw a new profile for Auguste Perret based on his understanding of local environments, affirming that the architect's specialty was not only reinforced concrete, but concrete used with respect for local traditions.

The research is divided into two main parts: the first is a brief review of the evolution of architectural style and the use of building materials in nineteenth and twentieth-century Egypt ; the second is an analysis of Auguste Perret's buildings built in the 1920's and 30's in Alexandria. The first part includes a discussion of the relationship between European styles imported to Egypt and the Nationalist movement that flourished at that time. Egyptian architects, neglecting vernacular and traditional values, were struggling to express their nationalism by "Egyptianizing" their buildings either by introducing Islamic or Egyptian motifs. Meanwhile, one of the most important results of the process of adaptation and borrowing from western methods was the wide application of reinforced concrete. This application was the outcome of European architects contributing to the occident and responding to the new socio-economic and technological conditions in Egypt.





The aim of the research is not to criticize the European influence on Egyptian architecture. Instead, it admits that this European influence characterizes nineteenth and twentieth-century Egyptian cities. It is by studying this influence that one can understand the different parameters under which Egyptian architecture is currently developing. For that reason, I felt obliged to include work by some of the world's most important architects (for example Adolf Loos, Eliel Saarinen, Frank Lloyd Wright) who built or proposed to build in Egypt. The awareness of such treasures could make local authorities as well as world preservation organizations realize that Egypt is not only a rich museum of antiquities but also a house of important modern buildings. And because examples are few and not well covered by the literature, these designs need immediate preservation attention. Moreover, Egyptian Antiquity law, which stipulates a minimum age of a hundred years for registering a building as part of the National heritage, must be reconsidered.

The second part of the thesis will exemplify modern Egyptian monuments by focusing on the work of Auguste Perret in Egypt. Unlike his contemporary "first generation modern pioneers" who did little work in Egypt, Perret got several design commissions in both Alexandria and Cairo. Most of these commissions are not only ignored by Egyptian authorities, but also neglected by art historians and architectural writers. It is sufficient to know, as stated before, that two of these buildings are not yet listed among Perret's designs in most of the architect's building lists developed by art historians. Paul Jamot, Marcel Zahar, Bernard Champigneulle and Peter Collins are the most noteworthy of these writers. It was only, as far as I know, in Fanelli and Gargiani's 1991 Italian book that these buildings were included as Perret's, although the authors claimed that they were never executed. Consequently, I will focus on these three buildings to confirm their attribution to Perret, and to present a case for preservation of modern Egyptian architecture. I will next address the question of how Perret influenced architecture in Egypt, and in turn, how existing Egyptian architecture influenced his work.

Since the reinforced concrete of these buildings is generally in good condition, Perret's construction methods and techniques should be analyzed in order to develop standards for the material's use in Egypt. A detailed plan for this analytical study is included. Its results will be important to upgrade the





reinforced concrete construction techniques that are the dominant means of construction practiced in Egypt today.

#### **Note on research difficulties**

During my research I confronted some difficulties that had arisen because of scarcity and often unavailability of statistical data. This is especially true in developing countries where most construction activities are carried out by individuals or groups that leave little or no documentation of their activities for analysis. Official records or documents are rare, inaccessible and, in many cases, unreliable. I experienced other obstacles during my site survey. I conducted several visits to Alexandria in the summer of 1992 and 1993 to investigate Perret's buildings in Wabour El Maya district. However, it was not possible for me to get close to the buildings because of the strict local security system applied in Egypt at that time. Nevertheless, the information and the photographs that could be gathered were sufficient to direct the research. Closer exterior investigation, interior analysis, and owners' interviews could open new insights, or might nullify some hypotheses that could have been incorrect due to my investigation from a distance.

#### **Note on Illustrations**

Two sets of illustrations are provided in the thesis: the first accompanies the text and illustrates a particular item; the second is gathered in Appendix I. The latter is a chronological collection of some of Auguste Perret's building drawings and photographs. During my description of each of Perret's buildings, I will refer to a number of an entry that will be shown into parentheses, as following: (entry #). This number coincides with the one in Appendix I. This will enable the reader to get a quick glimpse of the building to which I am referring. It will also help to formulate a brief understanding of the buildings that Perret built before and after this particular entry.

#### **Note on Transliteration**

In the text I have generally followed a simple transliteration of Arabic names, terms, and titles. In the text and in Appendix I, I maintained the French spelling for the well-known names of Auguste Perret's buildings. Consequently, I mostly kept the names in the form that they have appeared in both English and French publications.







## **1. Style and materials in Egypt 19th-20th centuries**

The first image that one can get once 'Egypt' is mentioned, is the Pharaonic Temples, or may be some of the Muslims monumental mosques. Since people often forget that Egypt is still a living country, the modern side of Egyptian cities is neglected. Even the Egyptian Antiquity law stipulates a minimum age of 100 years to designate a building as a historical monument. This chapter, though, will be an attempt to shed light on modern Egyptian architecture. During the investigation, the study will focus, in particular, on the early twentieth century. This will enable us to understand of the parameters, regulations and influences under which Egyptian architecture developed in general. It will also allow us to conduct a more specific research of the modern pioneers who built or designed in Egypt. A step further will be taken in the following part of the thesis to analyze Auguste Perret's (1874-1954), one of those pioneers, use of reinforced concrete in his Alexandrine buildings.

### **1.1. Stylistic evolution**

In this section, modern Architectural history will be briefly described, showing the most important moments in which Egyptian architecture experienced a distinguished development or perhaps a major shift from its evolutionary line. A special focus on the architecture in Egypt after the reign of khedive Ismail (1863-79), especially at the turn of the twentieth century, will be discussed in the following sections of this chapter.

In order to analyze Egyptian modern history, one should first understand that the reign of Muhammad Ali (1805-48) was a turning point in the history of Egypt. Historians consider this period as the start-up point of the history of 'modern' Egypt since from this moment Egypt was exposed to the West—the European cultural, social and political life. Therefore, architectural history in Egypt after the age of Pharos and before the 1952 Revolution, could be classified, as well, into two categories, considering the reign of Muhammad Ali as a break-point. For the purpose of the research, only architectural styles and building materials will be investigated.

The first architectural category flourished in Egypt after the Arab conquest of Egypt in 641, and ended in 1805 with the reign of Muhammad Ali. During



this thousand years, Egypt experienced many changes in architectural styles that always coincided with political environments. This intimate relationship between politics and architecture in Egypt at that time is briefly summarized by Sakr, in a recent publication. Sakr shows the evolution of architecture during this period of time, investigating the Fatimid monumental architecture until 1171; the Ayyubid arabesque (1171-1250), Bahri Mamluk salactite profiles (1250-1382), Circassian Mamluk geometrical patterns (1382-1517), Ottoman period and its pencil-like minarets (1517-1805) during which Egypt exhibited the French expedition (1798-1801). Sakr also shows external influences, for example the Coptic, Byzantine, Samarran, Mongol, Persian and Timurid art and architecture.<sup>1</sup>

During the reign of Muhammad Ali, Egypt witnessed a gradual decline of 'traditional architecture' and a break in its evolution. Muhammad Ali exported to Egypt Turkish architecture which had already been influenced by Europe. Relations with the West became stronger during the reign of Muhammad Ali's family who ruled Egypt for 147 years from 1805 until 1952.<sup>2</sup> A chronological review of the literature that dealt with architectural style in Egypt after the reign of Muhammad Ali shows an interesting evolution. The traditional private house before 1800's was made of bricks and stone, either plastered over or left bare. The roof was flat, covered with a coat of plaster, while the windows were made in the mashrabiyya style (window with latticework screen of carved wood) and rarely contained glass. However, Egyptians from the 1820s until Ismail's reign had begun to build dwellings following European modes of classical revivalism in what Clerget calls 'Style Grec' or 'Style Italien.'<sup>3</sup>

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<sup>1</sup>Mohamed Sakr, Early Twentieth-Century Islamic Architecture in Cairo, The American University in Cairo Press, 1992, pp. 1-7.

<sup>2</sup>The members of the royal family were: Muhammad Ali, 1805-1848; Ibrahim Pasha, April 1848-August 1848; Abbas Pasha I, 1848-1854; Said Pasha, 1854-1863; Khedive Ismail Pasha, 1863-1879; Khedive Tawfik, 1879-1892; Khedive Abbas Helmy II, 1892-1914; Sultan Hussein Kamal, 1914-1917; King Fouad I, 1917-1936; King Farouk I, 1936-1952.

<sup>3</sup>"C'est surtout à partir du règne de Mohammed Ali que succès du plan à l'eupéenne s'est affirmé, d'abord pour des raisons de mode, ensuite par nécessité de s'accomoder aux conditions nouvelles de la vie. Vers 1800, on appelait ce style le style grec. . . Puis vint le style à l'italienne, avec les galeries à arcades, les larges balcons . . ." Clerget, Le Caire, vol. I, Cairo, 1934, pp. 324-25. Clerget later in his book criticizes style italien because "l'absence de goût explique les ornements ridicules, les frontons prétentieux, les faux balcons de bois, le faux style italien, ...." Clerget, p. 344.





The utmost connection with the West, especially Paris, was during Khedive Ismail's reign (1863-79). Among the Khedive's concerns was, for example, to establish Cairo as Paris of the Orient. Moreover, he made the French architect De Curedel Rosso, the designer of Abdin Palace, his assistant. Consequently, not only building contractors were imported from Europe,<sup>4</sup> but also European architects were entrusted in the field of architectural design in the Egyptian cities during the 19th and the early 20th century. Most of Egyptian buildings, thus, were very similar to those erected in Paris or Rome, in their use of stone and plaster decoration, of marbles for steps and entrances, and increasingly elaborate iron-work. Egyptian architecture lost a remarkable amount of its traditions especially with Khedive Ismail's reign in 1863, which declared a period of rapid construction in Egypt.

Around the year 1900, a second important change took place with the introduction of reinforced concrete. Reinforced concrete provided means tall buildings with the required strength to stand firmly on the muddy soil close to the Nile, and the use of cement and iron-work used in building (1900-1908) offered a sharp decline in the price of construction.<sup>5</sup> The use of this new construction material announced the rise of a new twentieth century architecture in Egypt.

## 1.2. Early twentieth century

Owen points to a second period of rapid construction in Egypt, after Khedive Ismail's, which was the beginning of the 1890's, "given impetus by Egypt's increasing prosperity, by the growth in the number of foreigners, both residents and tourists, and the great enlargement of government activity." He explains the reason of this boom, considering the Tanzim department of the Ministry of Public Works files as his basis, by saying:

---

<sup>4</sup>For examples, see Janet Abu-Lughod, Cairo 1001 years of City Victorious, Princeton, 1971, pp. 105-106.

<sup>5</sup>For architectural style before the 1820s, see Edward Lane An Account of the Manners and Customs of the Modern Egyptians, Vol. 1, London, 1863, pp. 6-11; see M. Clerget, Le Caire, Vol. 1, Cairo, 1934, p. 309, 324 for the architectural style from the 1820s until Ismail reign; and see Rapport de la Commission du Commerce et de L'Industrie, Cairo 1922, p. 158, also Annuaire Statistique, Cairo, 1914, p. 381 for the introduction of reinforced concrete to Egypt, and for its convenient price as oppose to the high price of the locally-produced materials at the time.



In the decade between 1897 and the financial crisis of 1907, when the boom was at its height, the value of the cotton harvest doubled, Europeans invested almost as much money in Egyptian companies as they lent to Ismail, . . . The result was a huge and ever-growing demand for shops and offices, flats and hotels, which pushed land values up to astronomical heights.<sup>6</sup>

Referring to the National Bank report, published in 1948, which investigates the Egyptian Economic conditions from 1898 to 1948, one can deduce some political and economical events that had remarkable influences on the urban and architectural development of the country during that time. The first world war in 1918, for example, had ended with general inflation and political disturbance. The report shows that "the end of the war found Egypt in a period of prosperity. . . Egypt was inevitably affected by the post-war difficulties of other nations and had to adjust herself to the post-war boom and slump of 1921 and then again, after a period of relative prosperity, to the shock of the 'economic blizzard' of 1929-30 and the new currency disturbances which followed 1931."<sup>7</sup>

A direct result of this crisis was the introduction of blocks of flats with an average height of five to seven stories. The use of reinforced concrete as a structural material encouraged this trend. These blocks were mainly owned by individuals and rented to middle and lower class families. Their rent was imposed by the municipal authority according to the quality of the residencies. Unfortunately, a Rent Control law, started in 1940, froze all rents set at that time, and in the early 60's restrictions and even further reductions were made by the Revolutionary Government, dropping the return on income of landlords well below realistic values. Since that time landowners started to sell the dwellings to avoid the fixed rent system, and to earn immediate economical profit. This phenomenon led to a poor selection of building materials, and a cheap method of construction. It also led to the lack of attention that landlords would provide to their apartments' blocks.

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<sup>6</sup>Roger Owen, *The Cairo Building Industry and the Building Boom of 1897 to 1907*, in *Colloque International Sur L'Histoire du Caire*, Ministry of Culture of the Arab Republic of Egypt, General Egyptian Book Organization, 25 Mars-5 Avril 1969, pp. 337-350.

<sup>7</sup>National Bank of Egypt 1898-1948, *Year Book 1984*, Cairo: N.B.E. Printing Press, Rod El Farag 1949, p. 48.



### 1.2.1. European Building Industry in Egypt

The trend, started during Ismail's reign, to import foreign architects, building firms, and contractors continued in Egypt until the 1950's. Owen shows, according to 1917 census on workers in the Egyptian building industry, that numbers of the workers in each field of building industry; stone cutters, lime plasterer, roofers, locksmiths, carpenters, painters and unskilled laborers, contained a large percentage of Europeans. He also refers to a study by Jean Vallet to demonstrate that "the general ratio was four Egyptians to one European, with the exception of zincmen and plumbers, where the numbers were about there was a ratio of four Europeans to one Egyptian." He clearly states that the majority of Europeans were Italians and Greeks. Owen also show Vallet's notes on the annual migration of "Italian peasants who came to work in Egypt from November to March each winter when activities in their own fields were suspended."<sup>8</sup> From different kinds of statistical sources, Owen is able to conclude that the largest building firms were European, and that many of them had been founded by Italians.<sup>9</sup> Not only were they in charge of construction activities in Egypt, but also introduced new materials and techniques to the field. Volait, for example, points to the Naples' entrepreneur Nicola Marciani who was the first to use reinforced concrete in Egypt, according to Hennebique system, in the construction of a factory in Cairo, 1895.<sup>10</sup>

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<sup>8</sup>Roger Owen, *The Cairo Building Industry and the Building Boom of 1897 to 1907*, in *Colloque International Sur L'Histoire du Caire*, Ministry of Culture of the Arab Republic of Egypt, General Egyptian Book Organization, 25 Mars–5 Avril 1969, pp. 340-341. Owen in his study refers to Ministry of Finance, Statistical Dept., *The Census of Egypt taken in 1917*, Vol. II, Cairo, 1921, pp. 14-275, and Jean Vallet's work published as *Contribution à l'Etude de la Condition des Ouvriers de la Grande Industrie au Caire*, Valence, 1911, p. 6. Clerget mentions this seasonal European workers. See Clerget, *Le Caire*, vol. II, Cairo, 1934, p. 284.

<sup>9</sup>R. Owen, p. 341. Owen refers here to a description of the leading building firms contained in A. Wright (ed.), *Twentieth Century Impressions of Egypt*, London, 1909, pp. 322-69.

<sup>10</sup>This factory is considered one of the first buildings in the world that follows the Hennebique system. For a complete list of these buildings, see Perret, *Techniques & Architecture*, No. 1-2, October 1949, p. 46. Marciani was also the first contractor to use reinforced concrete in Egypt in 1863. See Mercedes Volait, *La Communauté Italienne est ses Ediles*, in *La Revue de L'Occident Musulman et de la Méditerranée; Alexandrie entre deux mondes*, no: 46, fourth trimester, 1987, p. 143.





### 1.2.2. Reinforced Concrete: a new building material

In order to draw an image of the building industry in Egypt at the turn of the century, one should analyze the building materials available at the time. For the purpose of this research, a special focus will be directed to reinforced concrete. From the time of its introduction to Egypt, in 1863 by the contractor Nicola Marciali, there were lot of interesting events that happened in Egypt related to the worldwide use of reinforced concrete. It is sufficient to know that François Coignet, who is considered among the first leaders to pour reinforced concrete, constructed the buildings for the Suez Canal Company in 1892-95, at Port-Tewfik and Port-Said. Moreover, François Hennebique, whose understanding of the material enabled him to invent his own system of construction, erected the Alexandrine train station, 1909. In addition, Marciali's factory in Cairo, 1895, was one of the first buildings that followed the Hennebique constructional system.<sup>11</sup> In addition to these facts, knowing that the reinforced concrete remains, nowadays, the main, if not the only, constructional material in Egypt, research and analysis should be conducted to understand its behavior and deterioration procedures, and its suitability to the vernacular and environmental architecture.

There are number of important questions which have never been asked, as far as I know, about certain aspects of the introduction of the reinforced concrete in Egypt. It is clear that this discipline must have been the recipient of large sums of money from public and private sources. To what extent was this investment controlled by foreigners? Who were the contractors and their labor skills? How many of the primary materials used were locally produced and how many came from abroad? These are all questions which require an answer if we are to have a proper understanding of the evolution of the building activity in Egypt in the 19th and the 20th centuries.

Unfortunately, there is a lack of historic information that deals with the answers to these questions. In this section, I will depict a few attempts that tackle the question of the building materials, especially the reinforced concrete. These attempts had never been pursued or elaborated. Further

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<sup>11</sup>Perret, *Techniques & Architecture*, No. 1-2, October 1949, pp. 39-46.





studies should be proceeded in this field. The main studies that I will be referring to are: Marcel Clerget's, 1934; Roger Owen's, 1969; and some articles published in the *l'Egypte Contemporaine* in the 20's and the 30's.<sup>12</sup>

## Cement

It is not clear in the literature when exactly the cement industry began in Egypt. However, Clerget states that it was not before 1900 that this industry began to be well developed and ameliorated. Clerget and Owen show that one of the largest and most important firms in Egypt, founded after 1900, is the Belgian S. A. des Ciments d'Egypte with its factory at Toura-Massara, which produced 25.000 tons of cement per year.<sup>13</sup> In addition to Massara factory, Clerget shows H  louan factory, 1930, which produced 100.000 tons per year, and Ghamra cement factory, near Cairo which produced reinforced concrete pipes with variable dimensions.<sup>14</sup>

However, Owen shows that "the low external tariff of 8% was insufficient to prevent a high degree of foreign competition, and there was no way of persuading the British authorities to raise it." It was for this reason, above all, that the S. A. des Ciments made a series of annual losses between 1907 and 1910. Owen adds that "Portland Cement could then be imported into Egypt at the price at which it scarcely paid to compete."<sup>15</sup> Nevertheless, regardless of its high cost, there was an enormous demand for imported cement. Evidence that shows this, is that its importation augmented from 258,000 LE in 1924 to 427,000 LE in 1925.<sup>16</sup> With the rise of Torah cement factory, 1927, and the

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<sup>12</sup>See also Mohammed Awad, The Impact of Economic Change on the Structure and Function of the Building Industry in Egypt (1925-1985), a doctoral dissertation presented to the Department of Architecture, Alexandria University, 1992, pp. 139-146.

<sup>13</sup>Clerget says that this cement shows excellent quality in the construction of the Nile bridges. Clerget, Le Caire, vol. II, Cairo, 1934, p. 282. See also Roger Owen, *The Cairo Building Industry and the Building Boom of 1897 to 1907*, in Colloque International Sur L'Histoire du Caire, Ministry of Culture of the Arab Republic of Egypt, General Egyptian Book Organization, 25 Mars-5 Avril 1969, p. 346.

<sup>14</sup>*Ibid.*, p. 283.

<sup>15</sup>Roger Owen, *The Cairo Building Industry and the Building Boom of 1897 to 1907*, in Colloque International Sur L'Histoire du Caire, Ministry of Culture of the Arab Republic of Egypt, General Egyptian Book Organization, 25 Mars-5 Avril 1969, p. 346.

<sup>16</sup>I. G. L  vi, *L'Egypte vue a travers l'Annuaire de Statistique*, L'Egypte Contemporaine, 1928.



expansion of Massara factory, 1931, local cement production then became competitive with the imposition of customs tariff on imported cement.

The period of World War II (1938-45) and after, demonstrates the British kinship to develop and encourage the expansion of local industries in order to satisfy the needs of the war. The British, then, emphasized the cement production and ceased its importation from Europe. Among the most important companies that emerged at that time is the Alexandria Portland Cement Co., 1948.<sup>17</sup>

### Steel

Metal industries remained little developed in Egypt. Clerget, when describing the metal industry in Egypt, does not mention any iron or steel manufactures that produce concrete reinforcement bars.<sup>18</sup> Owen clearly states that iron, as many other building materials, was obtained from abroad. Although he did not specify from where the iron was imported to Egypt, he shows, in a table-like comparison, that there were three kinds of imported iron: Iron and steel-work (batus ou laminés); 'fer fondu ouvré'; and non specified iron and steel-work. From this table, one can conclude that, at the turn of twentieth century, iron was the second imported building material after wood.<sup>19</sup>

Similar to the cement industry, the period of World War II demonstrates the British kinship to develop and encourage the metal production and discontinued its importation from Europe. Among the most important metal companies that emerged at that time were the Société Egyptienne pour Fer et Acier, Helwan, 1954, and the Construction Metallique d'Egypt (Egymet) established in 1896 registered and reorganized in 1953.<sup>20</sup>

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<sup>17</sup>For a list of companies that emerged at that time see Awad, p. 142.

<sup>18</sup>Clerget describes the large industry related to the copper, bronze. For the iron and the precious metals (gold and silver), Clerget states that they were limited to small scale atelier or to certain social ethnic or religious groups. Clerget, Le Caire, vol. I, Cairo, 1934, pp. 273-279.

<sup>19</sup>Roger Owen, pp. 346-347.

<sup>20</sup>For the list of companies that emerged at that time see Awad, p. 142.



### 1.2.3. The initiation of building regulations

For the first time in the history of Muhammad Ali's ruling family, King Fuad issued a constitution for the kingdom of Egypt on April 9, 1923 and established the first parliament. This constitution was a starting point in the regulation of several chaotic Egyptian disciplines that existed at the time. An example of these disciplines was the city planning and building regulations. Considering the economic crisis that Egypt experienced from 1926, caused by the reduction of the Egyptian cotton value and the effects of the first world war, one can assume that the local municipalities did not have the time to devote to monitor planning and regulations for city development. Nevertheless, confronting local population growth and European immigration, Egyptian local authorities realized that under these circumstances planning and building regulations were essential issues which needed to be addressed to manage this rapid evolution.

The first building regulations enforced in Egypt were in Alexandria. These, however, were incomplete from a town-planning point of view, despite the fact that in May, 1923, the Municipality obtained the approval from the Government to supplement the current regulations with certain Town Planning Clauses. It will be necessary for the analysis conducted later on Auguste Perret's Alexandrine structures built in the 1920's and 30's, to state 'The New Lay-Out' part of these regulations.<sup>21</sup> The applicability of these regulations will be then investigated.

- a) Certain quarters and streets of the Town can be reserved by the Municipality exclusively as residential.
- b) At least one side of each block of land to be used for building shall front on to a public street.
- c) All building land of which the area, shape or position of the site makes it impossible to apply paragraph (b) in regard to existing public streets shall be considered as a new lay-out.
- d) In all new lay-outs for building purposes the proprietors must reserve for streets which will become public an area equal to one-third of the total area to be laid out. In the case of existing streets bordering

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<sup>21</sup>The regulations consists of 4 main sections under the following headings: (1)New Lay-Out, (2)Planning of Streets, (3)Width of Streets, Carriageways and Footpaths, (4)Angles to be Splayed or Rounded.





the land to be laid out, half the width of these streets shall be included in the calculation of the required area of one-third of the total.

e) All lay-out plans or planning schemes must be based on the alignments shown on the general Plan of the city approved by the Municipality on June 15th, 1921 (City of Alexandria) Town Planning Scheme) on which, however, the Municipality may make modifications.

f) All plans dealing with the alignment, width, arrangement and levels of streets must be approved by the Municipality.

g) No construction can be commenced before the approval of the Municipality had been obtained.<sup>22</sup>

These regulations contained the necessary provisions for giving effect to a successful town planning scheme. They included the proper laying out of undeveloped or unbuilt areas as well as the improvement of built areas, the width and alignment of streets and footpaths, the area of street surface in relation to the total area of land, and the respect of the historic or religious monuments.<sup>23</sup> However, no control on the façades of buildings was attempted, but good suitable architecture was encouraged by the Municipality.<sup>24</sup>

### 1.3. Egyptian architects versus European architects

#### 1.3.1. Nationalism of the Egyptian architects

Twentieth-century Egyptian architecture was a product of both European and Egyptian architects. At the end of the 20's, several Egyptian architects who received their architectural education in Europe came back to Egypt and started to take over the building activity there. Among those architects, Abdel Gawad includes: Mustafa Pacha Mahmoud Fahmy, Aly Bey Labib Gabr,

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<sup>22</sup>For a complete account of these additions, see M. Riad, *Alexandria: Its Town Planning Development*, The Town planning Review, vol. XV No. 4, December, 1933, pp. 233-248.

<sup>23</sup>The last consideration, in which the historic and the religious monuments should be respected, was a new trend towards the preservation of the Egyptian heritage. Earlier, during the reign of Ismail, Ali Moubarak, the minister of the public instruction, said: "A-t-on besoin de tant de monuments? Quand on conserve un échantillon, cela ne suffit-il pas?". He also added talking about Bab Zouila, which was a famous place for criminals execution in Fatimid Cairo, "Nous ne voulons plus de ces souvenirs-là; nous devons les détruire comme les Français on détruit la Bastille." Quoted from Marcel Clerget, Le Caire, vol. I, Cairo, 1934, p. 337.

<sup>24</sup>The Municipality used to give prizes to the architects of the three best buildings erected during the year, while the proprietors had the taxes on these buildings remitted for a year. *Ibid.*, p. 247.





Mohamed bey Raafat, Abou Bakr Khayrat, Mahmoud Riyad, and others.<sup>25</sup> The first generation Egyptian architects,<sup>26</sup> who returned from scholarly missions to Europe between 1908 and 1931, became the nuclei of the development of a new 'national architectural style'. Though, some of them followed the European modes that they studied abroad.

It should be added that the concern with nationalism existed as early as Orabi's revolution which started in 1882 during the British occupation. The general Nationalism movement which was kept dormant until the 1919 Sa'd's revolution rapidly extended in Egypt after the first world war. That revolution aimed to give practical expression to the national spirit, of which one aspect was architecture.

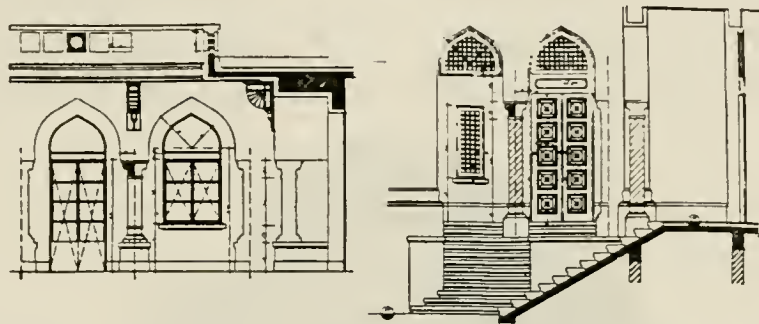


Figure (1): Abbasiya Hospital, details, Cairo, 1939. Mahmoud Riyad, architect. (Volait, p. 46)

Apart from those who followed European modes of architecture, Egyptian architects fell into three groups debating to define what modern Egyptian architecture should look like. The first group saw a revivalism of Mamluk architecture is the only answer since the Mamluk mode of architecture is the only Islamic mode that originally flourished in Egypt.<sup>27</sup> A perfect example of

<sup>25</sup>Tawfik Abdel Gawad, *'Amaliqa El Emmara fi el Karn el Eshreen* (The Pioneers of Architecture in the 20th Century,) Cairo. 1989, pp. 138-139. Abdel Gawad drew a special attention to Mostafa Pacha Fahmy, Sayyid Karim and Hassan Fathy.

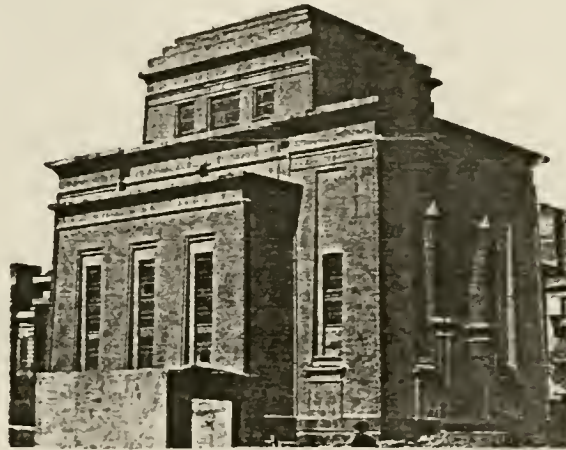
<sup>26</sup>For a complete account on the formation of the new Egyptian generation architects and their scholastic missions to Europe, see Volait, *l'architecture moderne en Egypte at la revue al-'imara* (1939-1959), Cedej: Cairo, 1988, pp. 19-40.

<sup>27</sup>Mamluk mode is that architectural style that flourished in Egypt under the rule of Bahri Mamluk (1250-1382). The key aspects of Mamluk mode of architecture are: the extensive use of stalactites in all architectural elements (portals, minaret's balconies, domes, column's capitals); the prevailing of pointed-arched portals; the domination of ribbed decorated domes. See Sakr, *Early Twentieth-Century Islamic Architecture in Cairo*, The American University in Cairo Press, 1992, pp. 4-5, see also Behrens Abouseif, *Islamic Architecture in Cairo: An Introduction*, Cairo, 1989, p.9.



this Mamluk revivalism mode is Mahmoud Riyad's Abbasiya Hospital, Cairo, 1939.

The second group preferred an ancient Egyptian revival, otherwise known as the neo-Pharaonic style, to the Islamic one. This group found it to be a more prestigious style, particular to Egypt, as well as a more convincing style for both Muslims and Copts, thereby expressing a principal idea of the 1919 Revolution. Moreover, the supporters of Pharaonicism believed that the Mamluks were foreign conquerors and not native Egyptians, the ancient Egyptian rulers, on the other hand, were indigenous leaders. Al-Asad shows that the former group "argued that, at best, the Mamluk revival could only represent the Muslims of Egypt, but that the Egyptian revival represented all Egyptians, Muslims, and Copts."<sup>28</sup> The Mausoleum of Sa'd Zaghlul, 1928, and the Pyramid Pavilion, Giza, 1946, built by Mustafa Fahmi, are examples of this trend.<sup>29</sup>



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Figure (2): The Mausoleum of Sa'd Zaghlul, Cairo, 1928. (Volait, fig 9 p. 41)

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Despite being superficial veneer, the two latter styles are a deep expression of social change, a slow collective reappropriation that parallels a political movement of Egyptian renaissance. Volait's argument towards this

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<sup>28</sup>Mohammad Al-Asad, *The Mosque of Al-Rifai In Cairo*, *Muqarnas*, vol. 10, Leiden–E.J. Brill, 1993, note 37, p. 124.

<sup>29</sup>Mustafa Pasha Fahmi (1886-1972) is an Egyptian architect graduated from the Ecole des Ponts et Chaussées in Paris. After his return to Egypt in 1912, he was appointed as the first Egyptian architect in the department of architecture and design in the Public Buildings Service, of which he became the director in 1926. See Abdel-Gawad, Tewfik. *'Amaliqa El Emmara fi el Karn el Eshreen*, Cairo, 1989 p. 148, also Tarek Sakr, *Early Twentieth-Century Islamic Architecture in Cairo*, 1992, p. 16.



architectural movement is something that could be "an expression of a search for identity."<sup>30</sup>

The last group refused to admit any of the various revival styles as a suitable interpretation of the idea of nationalism. From their point of view, it was illogical to build in the twentieth century following the examples of the past. The architect Sayyid Karim stated that "the construction systems in Islamic architecture resulted primarily from the potentialities of the existing materials." He added that "if Arabs had built in steel and reinforced concrete, they would not have used arches or domes."<sup>31</sup> Sayyid Karim's design for an Islamic congress Hall in Cairo in 1957 is a perfect example for this trend.

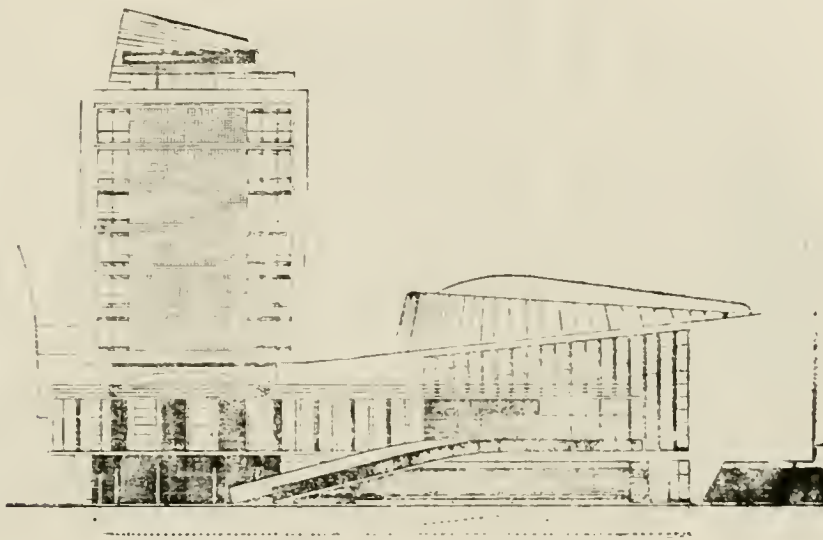


Figure (3): Islamic congress Hall, Cairo, 1957. Sayyid Karim, architect. (Abdel-Gawad, p. 310)

### 1.3.2. European architects practicing in Egypt

European architects, having graduated from European schools of architecture, executed their works in the prevalent styles and trends which they had studied. In addition to the revival styles, Eclecticism, Art Nouveau,

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<sup>30</sup>Mercedes Volait, and Robert Ilbert, *Neo-arabic Renaissance in Egypt, 1870-1930*, *Mimar*, 13, 1984, p. 34.

<sup>31</sup>Sayyid Karim, *al-Tabi' al-qawmi wal-'imara fi Misr*, *al-'Imara* V-VI, 1940, p. 274, quoted from Sakr, p. 16. Sayyid Karim got his architectural diploma from Polytechnic faculty, Cairo University, 1933, and B.Sc. and Ph.D. in architecture from Zurich University. He was the first Egyptian architect who got a Ph.D. in architecture. For a complete account on Sayyid Karim architectural career, see Tawfik Abdel-Gawad, pp. 161-227.





Expressionism, Cubism and International architecture, they also developed what may be called the neo-Islamic style by reintroducing traditional details and patterns as an external decoration on Western-designed buildings. For them the idea of revivalism included this exotic Islamic mode of architecture that existed in Egypt. The buildings of G. A. Loria in Alexandria were perfect examples for this manner.

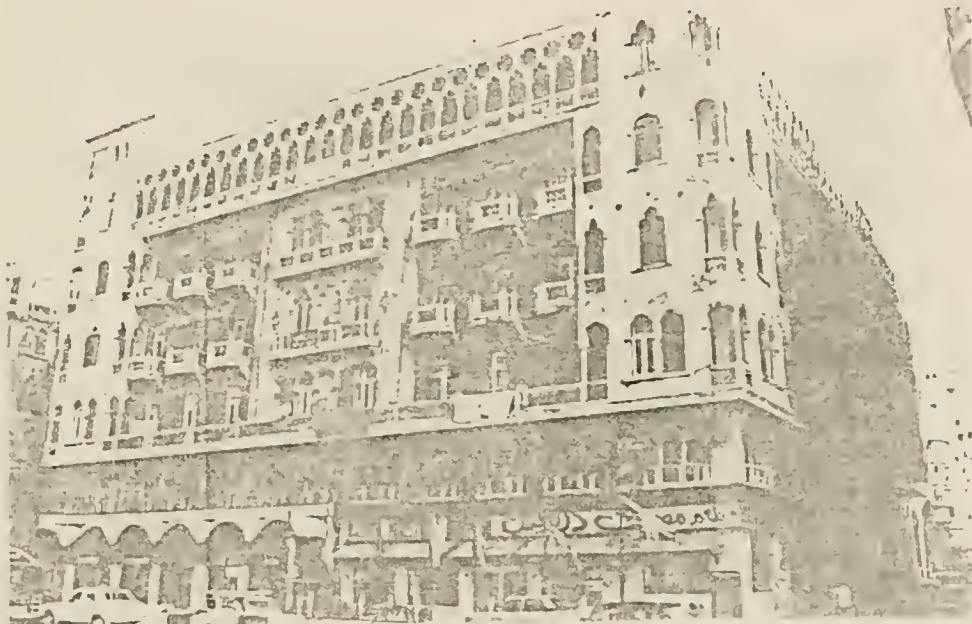


Figure (4): Apartment building, Alexandria. G. A. Loria, architect.  
(Awad, Italian architecture)

One group of European architects found in Egypt a perfect land in which to experiment new modes of architecture flourished at the turn of the 19th and 20th century. Being attached to the revivalism architectural trend, some European architects took advantage of their commissions in Egypt to build according the International style initiated in early twentieth century,<sup>32</sup> before

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<sup>32</sup>The term International Style was not used until the 1932 exhibition of the same name organized at the Museum of Modern Art in New York by Philip Johnson and Henry-Russell Hitchcock in which Le Corbusier, Walter Gropius, J.J. Oud and Mies Van der Rohe were acknowledged as the leaders of a new style in architecture. See Henry-Russell Hitchcock, Architecture: Nineteenth and Twentieth Centuries, The Pelican History of Art, 1989 edition, first published in 1958, p. 513.





doing so in their homeland. An example for that is the original design of the Italian School had been executed in Chatby, Alexandria, 1931-1934, designed by Clemente Busiri-Vici (1887-1965), a member of a Roman architects family. Volait states that "Cette œuvre marqua un tournant dans l'œuvre même de Burisi-Vici, qui s'était montré jusque là plutôt classique dans ses projets romains. D'une certaine manière, ce fut l'occasion pour lui d'appliquer les principes formels du tout jeune mouvement italien d'architecture rationnelle, qui venait d'être fondé à Rome (1928)."<sup>33</sup>



Figure (5): Italian School in Chatby, Alexandria, 1931-1934, Clemente Busiri-Vici, architect. The building is now used as the agricultural department building, Alexandria University. (Photographed by the author, December, 1993)

Apart from buildings, some Oriental writers, who dealt with the Egyptian cities, had a clear idea on the architectural styles that should be followed in Egypt at the turn of the century. Clerget, who wrote one of the most significant book on modern Egypt, emphasizes the harmonization with the 'Arabic' style, the respect of the pharaonic architecture. However, he does not forget his French background considering Renaissance and Louis XVI

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<sup>33</sup>Mercedes Volait, *La Communauté Italienne et ses Ediles*, in *La Revue de L'Occident Musulman et de la Méditerranée; Alexandrie entre deux mondes*, no: 46, fourth trimester, 1987, pp. 148.



architecture among the acceptable building modes. For him, then, the most significant examples of buildings erected at that time, 1934, were those who showed:

alliance charmante du style moderne et du style arabe, avec bassin, fontaines, cours, balustrades ajourées, panneaux de bois; usage de la brique rouge apparente dans un style Tudor; revêtements divers de belle brique; enduits rustiques, soubassements en pierre artificielle, imitant la belle pierre de taille; emprunts modérés et judicieux à l'architecture pharaonique; immeuble locatifs en style moderne sobre, sans ornement tapageur de plâtre ou de pierre; frises discrètes en mosaïques, courant à l'étage supérieur: style Renaissance ou Louis XVI, sans recherche pompeuse.<sup>34</sup>

#### 1.4. The first pioneers

One who investigates the work of the European architects in Egypt at the turn of the century should take a special look to the intervention of the so called the 'first generation of modern architecture', as Hitchcock identifies them.<sup>35</sup> Among those architects who built or proposed a design in Egypt are: Adolf Loos, Frank Lloyd Wright, Eliel Saarinen and August Perret. The first three pioneers' interventions will be discussed in this section. The following chapter will be entirely devoted to Auguste Perret's contribution.

##### 1.4.1. Adolf Loos' Classical approach, 1910

Loos proposed a design for a Department Store (Stein), in Alexandria, 1910. He must have liked this design, which is a water color executed by one of his pupils, R. Wels, that he hung it in his Vienna apartment until he died.<sup>36</sup> Gravagnuolo describes the design as a "substitution of the neo-gothic stylistic features of the new cathedrals of consumption by a classicist bricolage in which Hellenistic reminiscence are mixed up with allusions to Pharaonic

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<sup>34</sup>Clerget, Le Caire, vol. I, Cairo, 1934, p. 345.

<sup>35</sup>Hitchcock makes a clear distinction between the different generations of modern-architecture's leaders; "one group, born in the late 1860s, constituted the first generation, a group born some twenty years later formed a second generation," and 1930s generation that since Hitchcock's book has come to maturity. Henry-Russell Hitchcock, Architecture: Nineteenth and Twentieth Centuries, The Pelican History of Art, 1989 edition, p. 419.

<sup>36</sup>The original drawing is kept today in the Adolf Loos room of the Historical Museum of Vienna. A colored publication of the perspective design is published in Benedetto Gravagnuolo's Adolf Loos, 1982, p. 142.





architecture."<sup>37</sup> Münz and Künstler, however, emphasize its modernity in its rational tectonics.<sup>38</sup>

The design follows Clerget's description, though earlier, of the most significant modern architecture of Egypt. It shows some aspects from the 'Arabic' style shown in the distinctive horizontal stone joints that coincide with horizontal details of the building to the right of the perspective. The stepped back aspect of the upper floors, and the monumental scale of the four intermediate ones recall pharaonic architecture. However, Loos expresses his European background by introducing Ionic orders that match with the revivalism movement in Europe. In general, Loos' combination of motives creates an alien architecture that does not fit with the environment shown in the perspective.

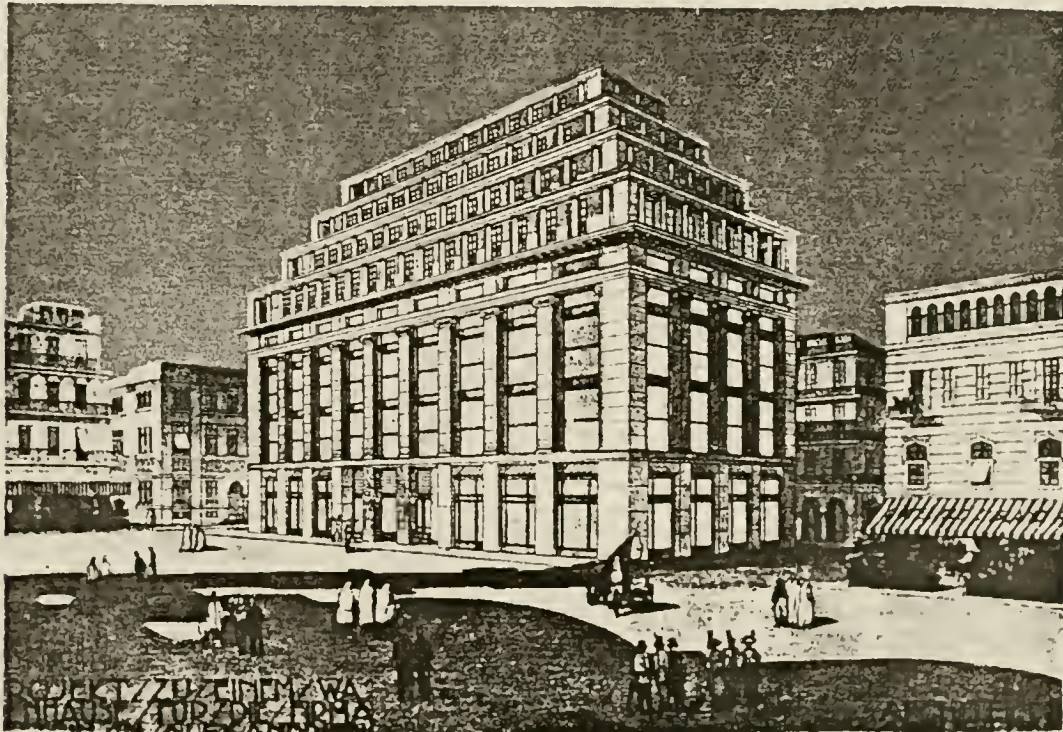


Figure (6): Perspective of a Department Store (Stein), Alexandria, 1910. Adolf Loos, architect, after a water color by R. Wels. (Münz and Künstler, p. 129)

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<sup>37</sup>Benedetto Gravagnuolo, *Adolf Loos; Theory and Works*, Rizolli: New York, 1982, p.142.

<sup>38</sup>See Ludwig Münz and Gustav Künstler, *Adolf Loos; Pioneer of modern Architecture*, Frederick A. Praeger: New York, 1966, pp. 129-130.



#### 1.4.2. Eliel Saarinen: a design of Cairo hospital, 1921

Saarinen proposes, for a competition in 1921, a design for the Cairo Hospital–Qasr El Aini Hospital and Medical School,<sup>39</sup> whose analytical approach, according to Hausen, “yielded a small town instead of a hospital.”<sup>40</sup> Saarinen's understanding of the climatic condition in Egypt guided him to follow an interconnected system of colonnaded courtyards within a massive solid exterior. Saarinen's proposal could be briefly described as a group of two and three (partly seven-story) limestone and/or brick buildings, situated on a 19.5 hectare area. The central axis formed of pilasters and water pools gathers all the activities of the hospital by its interconnection with a secondary court-spaces.

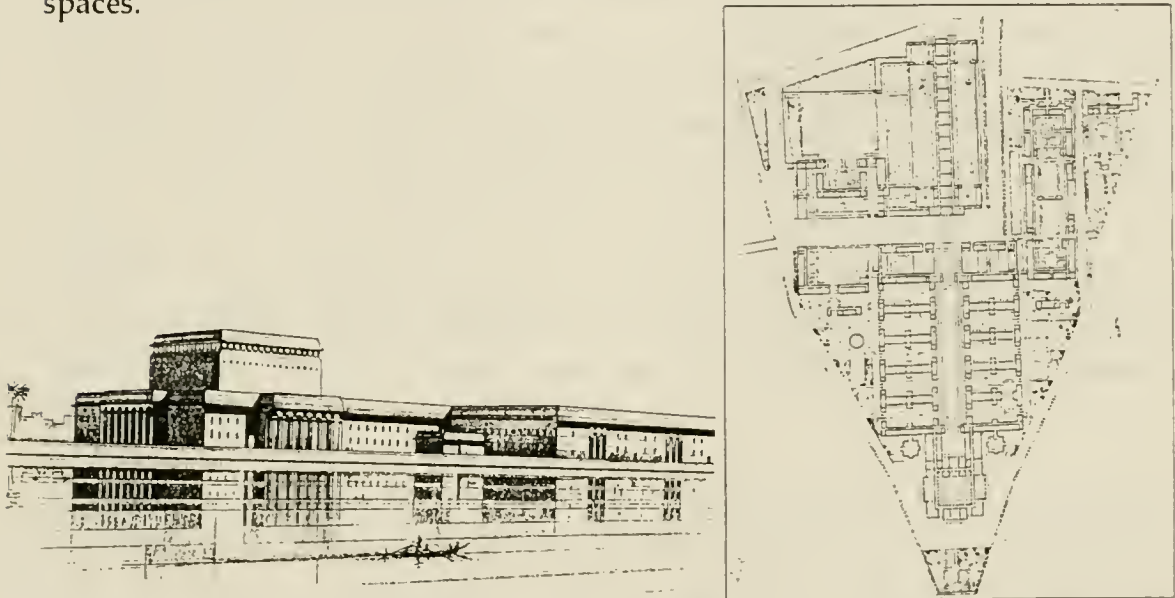


Figure (7): Cairo hospital, competition entry. Eliel Saarinen, 1921. (Hausen, p. 212 and 334)

Hausen's interpretation about this design is that “this big hospital complex was a forerunner of the structuralism aspirations of the 1960s, e.g. the Hospital for Venice by le Corbusier, and the Freie Universität Berlin by Candilis-Josic-Woods.” Hausen also points that the design is “representative

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<sup>39</sup>The Egyptian government held an architectural competition in October, 1921, to design Qasr El Aini Hospital and Medical School, Rôda island, Cairo. The Consultant and sole judge was John W. Simpson, chairman of the Royal Institute of British Architects. Of the entries received in the initial competition, six were selected for the second stage. Saarinen's proposal was not among these.

<sup>40</sup>M. Hausen, K. Mikkola, A. Amberg and T. Valto, Eliel Saarinen; Projects 1896–1923, MIT press: Cambridge, MA, 1990, p.212.





of the Olmsted tradition of American campus design e.g. Stanford University, Palo Alto in California, and Washington University, St. Louis, Mo."<sup>41</sup>

Apart from Hausen's structural and urban analysis of the design, the design for the Cairo Hospital showed Saarinen's kinship with Egyptian vernacular architecture, though the Pharaonic-temple scheme was over stated.

#### 1.4.3. Wright's disassembled structure, 1927

Frank Lloyd Wright designed in 1927 prefabricated beach Cottages in Ras-el-Bar, Dumyât. These structures were meant to be disassembled each year and stored during the spring flood season. The wooden box-board cabins roofed in canvas which were anchored to poured concrete slabs, when in use, recall the charming desert camp 'Ocotilla' that Wright built in 1929 as a working camp to make the working drawings of the San Maros-in-the-Desert resort hotel. In spite of the great amount of research on Wright's buildings, these structures were mentioned in only a few of them; William Storrer's, Bruno Zevis' and Bruce Brooks Pfeiffer's.<sup>42</sup> The latter, however, published Wright's drawings of the design. Pfeiffer states that these structures collapsed when the first season was over.<sup>43</sup>

Wright's technical adaptation of his cabins to the specific features of Ras-el-Bar, emphasizes his organic architecture that mainly relates the building to its site. However, he did not take into account, by opening his cabins into a central space, the required privacy of each structure that should satisfy the Egyptian social-life quality.

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<sup>41</sup>ibid., p.212.

<sup>42</sup>Mentioned (without illustrations) in entry number 223 in William Allin Storrer, The Architecture of Frank Lloyd Wright; a Complete Catalog, The MIT Press, Cambridge: MA, 1974; in Wright's building list published in Bruno Zevis, Frank Lloyd Wright, 1980, Verlag für Architektur Artemis Zürich, Les Editions d'Architecture, p. 277; and in Brooks Pfeiffer's Frank Lloyd Wright Monograph 1924-1036, vol. 5 (edited and photographed by Yukio Futagawa), A.D.A Edita Tokyo, 1985, p.46.

<sup>43</sup>Brooks Pfeiffer Frank Lloyd Wright Monograph p.46. The author also point that the correspondence between Mr. Wright and the authorities in Egypt exists in the Taliesin archives.



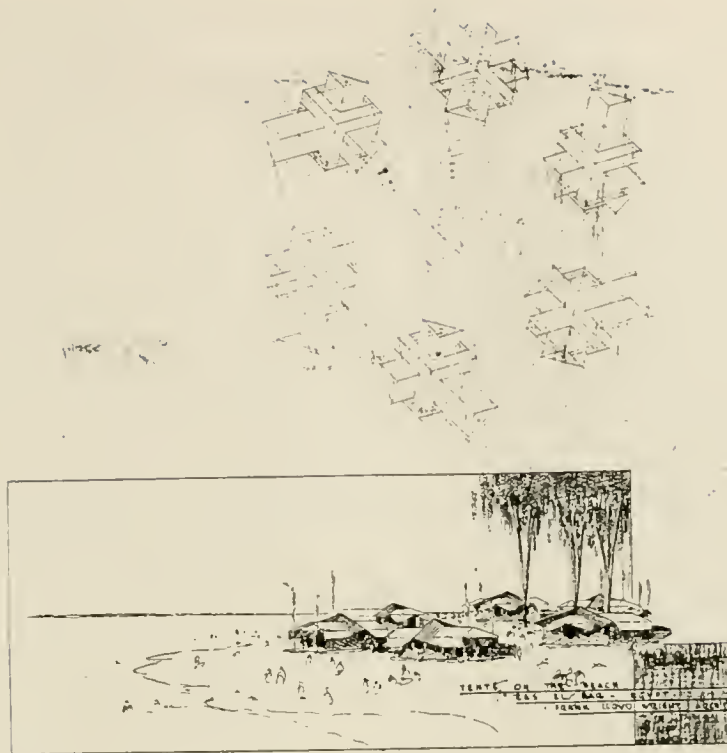


Figure (8): Ras-el-Bar, Vacation Cabins by the Sea, Dumyât, Egypt, 1927, Frank Lloyd Wright, architect. General Layout and perspective. (Pfeiffer, vol. 5 p. 46)

Apart from this cottages, Wright's theories were very admired by the Egyptian architects. Volait mentions that Frank Lloyd Wright's name was one of the most repeated in the 'Imara', an Egyptian architectural review 1939-62. She also mentions that he was the only foreign architect who received so well recognition in Egypt that special official festivals were organized to celebrate his visit to Cairo in May, 1957.<sup>44</sup>

<sup>44</sup>Volait, L'Architecture Moderne en Egypte et le Revue El Emara 1939-59, CEDEJ. Cairo 1989, p. 65.







## 2. Analysis of A. Perret's buildings in Alexandria: Introduction

Since its introduction in Egypt, 1863, reinforced concrete seems to have gotten little appreciation in the building industry. It was always considered as a constructional 'ugly' material that should be veneered with a more noble one. It was not before Auguste Perret, in 1926, that the first unfinished reinforced concrete building was erected in Egypt. This chapter will investigate Perret's theory and practice in general. A special focus will be devoted to analyzing his point of view of what a reinforced concrete building in Egypt should look like.

After the expansion of the local cement and steel production in the 1940's and 50's, reinforced concrete quickly took over the building industry. It was, and still is, the most inexpensive building material. However, no serious attempts followed Perret's examples of exposed concrete in buildings, except later in the 70's and 80's demonstrated by the work of Hassan 'Izat abou-Gad in Alexandria; the University of Alexandria conference Hall, the Research Institute, and the Institute of the Naval Academic research.

## 3. Auguste Perret

### 3.1. Perret's life

The father, Claude Marie Perret was a Burgundian stone mason. He left his province and settled in Paris, where he was accused of having participated in setting fire to the Tuilleries. Later he fled to Belgium to escape the Versailles repression. In Brussels his three sons were born after two daughters: Auguste, on February 1874, Gustave in March 1876 and Claude in July 1880. The family was flourishing, but when the amnesty of the Commune rebels was voted on July 11 1880, the father decided to give up everything and return to Paris where he founded a general building firm. Abram points to the different location of this firm by time; it first became "the 'Entreprise Perret et Fils' (1896, 43 rue Rocher, Paris 8), then the 'Entreprise Perret-Architectes-Constructeurs-Béton Armé', situated initially at 25a de la rue Franklin, Paris 16 and then from 1930 at 55 rue Raynouard, Paris 16."<sup>1</sup>

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<sup>1</sup>Joseph Abram, *An Unusual Organization of Production: the building firm of the Perret Brothers, 1897-1954*, Construction History, vol. 3, 1987, p. 79.





Auguste and Gustave spent their childhood in their father's building sites where they became familiar with the process of construction. At this early stage of his life, it seems that Auguste demonstrated genius practices in the field of construction. Abram points to his invention of a system of metal ties to hold the structure of the Tour the Temple, 1889.<sup>2</sup> The father, then, sent them to the Ecole des Beaux-Arts where they both joined Guadet's atelier.<sup>3</sup> The Perret brothers were then drawn to both Guadet's doctrine (*Eléments et Théorie de l'Architecture*, Paris, 1901), and their mother's own copy of Viollet-le-Duc's *Dictionnaire Raisonné* (1854-68).

In spite of their remarkable scholarly achievements, the two brothers left the Ecole without getting their diploma due to their obligation to work with their father, and Auguste's military service.<sup>4</sup> Auguste and his brothers worked for their father's firm until the later died in 1905. Then, Auguste practiced architectural design and construction in collaboration with his brothers under the name of *Perret Frères*, until Auguste death on February 25th, 1954. From a practical point of view Perret had an extensive building list that he either constructed, designed, or both. A building and project list of the architect is included as appendix 1 in this study.<sup>5</sup>

### 3.2. Ideas that influenced Perret's architecture

“Ce qui paraîtra bientôt le plus vieux, c'est ce qui d'abord aura paru le plus moderne.”<sup>6</sup>

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<sup>2</sup>The Tour du Temple is a temporary structure of light materials that his father had to build for the Universal Exhibition. Ibid. p. 79, and note 28 p. 92.

<sup>3</sup>Auguste entered the Beaux Arts in July 1891 (he was 17 years old). Gustave followed him two years later. For the influence of the Beaux arts ideas, especially Guadet's, on the two brothers' development see Ibid. pp. 79-80.

<sup>4</sup>J. Mathews also points to an interesting reason why Auguste did not get his diploma is that “probably because had he become a qualified architect he would not have been allowed to be a contractor at the same time.” J. Mathews, *Rational Concrete Architecture; Auguste Perret's Ideological Background and its Expression in his Formative Buildings*, a thesis presented to the Cambridge Faculty of Architecture & History of Art, May 1972, p.9.

<sup>5</sup>Apart of 9 undated projects that were attributed to Perret, I count 274 projects that Auguste Perret was involved in between the 1889 and 1954. Of these project, 157 project were constructed (22 of these were not design by Perret), and 117 projects were kept in the state of design. For a complete list of Perret's work see appendix 1.

<sup>6</sup>Extracted from *Les Faux Monnayeurs*, quoted from Marcel Zahar, *Auguste Perret*, Paris: Editions Vincent, Fréal et Cie, 1956, pp. 8.



Perret's discovery of new aesthetic values in the architectural use of concrete has of course its background that affected him elaborating his ideas. In order to consider the background of Auguste Perret's architectural theory and practice it will be necessary to look briefly to the following subheadings:

### 3.2.1. Viollet-le-Duc

Les Monuments perissent, mais ce qui ne doit perrir, c'est l'esprit qui a fait élever ces monuments, car cet esprit c'est le notre. C'est l'âme du pays.

Viollet-le-Duc

Auguste was familiar with Viollet-le-Duc's *Dictionnaire Raisonné* (1854-68) because he read his mother's own copy. Perret in an interview says that "Viollet-le-Duc was my real master."<sup>7</sup> Viollet in his book affirms that the civilizations which had made the greatest impression on history were those in which traditions were the most reflected theme. Le-Duc's attempt was not to imitate the past, instead he was trying to extract principles from the tradition modes so that they could be used according to the modern view. For him, art in order to exist must recognize the environment in which it is developing.

Although Perret gained little information from Viollet-le-Duc regarding the use of concrete,<sup>8</sup> he was influenced with "his ideas of structural integrity, his insistence that architecture could only achieve authentic new forms if these were derived from the undisguised application of new structural system, and his unhesitating condemnation of those who clothed new structural materials in stucco of brick."<sup>9</sup>

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<sup>7</sup>Perret added that "it was he who enable me to resist the influence of the Ecole des Beaux-Arts". A. Perret, *Architecture d'Aujourd'hui*, October, 1932, pp. 14.

<sup>8</sup>The *Dictionnaire raisonné de l'architecture française du XIe au XVIe siècle*, (1854-75) contained a short discussion on the concrete construction of the Roman Pantheon, and an article on béton which deals superficially with the technique.

<sup>9</sup>Peter Collins, *Concrete: The Vision of a new Architecture, a study of Auguste Perret and his Precursors*, 1959. p. 158.



### 3.2.2. Theories of Julian Guadet

Julian Guadet was a pupil of Henri Labrouste (1801-1875),<sup>10</sup> and acted as the general inspector of the French civil buildings. He taught architectural studio to Auguste Perret and his brother during their studies in the Ecole des Beaux-Arts. Being a colleague and friend with his son, Perret had a good relationship with his professor. Guadet stuck to the Beaux-Arts concept of classical design, nevertheless his awareness of classical scale, proportion, and beauty, and his method of analyzing architectural elements had a great influence on Perret's work. For Guadet, buildings had to be rational and functional. The professor says, in his *Elément et Théorie d'Architecture*, that the term 'classical' did not mean to be exclusive or to be biased in favor of a particular pre-conception. Guadet also emphasizes the idea that architecture should be constructable, and that "the final building should not express anything other than the structure."<sup>11</sup>

Guadet's ideas of true structural expression, harmony, proportion, beauty were followed by Auguste Perret in his designs, though away from the Beaux Arts academic style. To what extent the pupil learned from his professor in term of reinforced concrete is not clear in the literature. However, it should be mentioned that Auguste, in the beginning of his career, 1908-10, constructed three reinforced concrete buildings designed by J. Guadet: Hôtel Particulier avenue Elisées-Reclus, 1908; the Voyages et Travaux d'entreprise, French Legation, 1908-10; and Hôtel Particulier Guadet, 1912-13.<sup>12</sup> The association of Auguste and his professor in the construction of these buildings had of course elaborated, from a practical viewpoint, Perret's understanding of the reinforced concrete.

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<sup>10</sup>Henri Labrouste is considered the most influential Classical Rationalist of the nineteenth century. He gained his academic reputation by measuring the Greek temples at Paestum. It was his analysis of the structural components which was to constitute a revolutionary effect on contemporary thought. See Neil Arthur Levine, *Architectural reasoning in the age of positivism: the neo-Grec idea of Henri Labrouste's Bibliothèque Sainte-Geneviève*, 1975, also see David Van Zanten, *Designing Paris: the architecture of Duban, Labrouste, Duc, and Vaudoyer*, Cambridge, Mass.: MIT Press, 1987.

<sup>11</sup>Guadet also says "L'architecture a pour but les constructions, elle a pour moyen la construction" Guadet, *Elément et Théorie d'Architecture*, vol. 1, p. 194.

<sup>12</sup>See entries No. 24, 26 and 33, appendix I.





It should also be mentioned that through Guadet's studio Perret was introduced to Choisy, whose theories influenced the formation of his architectural rationale. Perret, in a discussion with Pierre Vago said "Si seulement tous les architectes avaient lu Viollet-le-Duc et le Choisy!"<sup>13</sup>

### 3.2.3. Architecture of Antiquities

The teaching at the Beaux-Arts, at the turn of century, fell under the pastiche of classical models, using Vitruvius and Alberti as its dubious theoretical basis, irrespective of modern life styles and technology. Much of the work produced by other architects in Perret's period of time was nothing more than the adoption of irrelevant Italianate ornaments introduced into French buildings in the early Renaissance. Perret, though opposing this trend, did not ignore the architectural values that could be adapted from the antiquity modes so that they could be used according to the modern view. For him the true architecture was found in Greek and Egyptian buildings, because both were developed from their environment.

#### Greek Architecture

A locomotive has character, the Parthenon has both character and style.

A. Perret

Auguste believed that the orders of Greek architecture were the structure itself, so that the structure and their appearance were the same. Take away the order and you destroy the monument.

In addition to structural values which Greek architecture introduced to A. Perret, the optical refinement proportion practiced in Greek architecture captivated Auguste. He provided a slight upward curvature to his beams in order to correct their optical alignments. Other such examples are: the slightly outwards curvature of the whole façade of the Research Laboratories, and Perret's landscape design for Gustave Aghion villa in Alexandria, 1926.<sup>14</sup>

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<sup>13</sup>Pierre Vago, *Perret une Etude de Pierre Vago sur L'Œuvre complète d'A. G. Perret, L'Architecture D'Aujourd'hui* (special issue on A. Perret), October 1932, p. 15.

<sup>14</sup>See detailed analysis of the villa and its landscape design in the following section of the study.





## Egyptian Influence

Most of the literature explaining how Perret's background influenced his architectural practice is based on the previous explained subheadings. However, it should be added, if not highlighted, the influence of Auguste's trip to Egypt. Consequently, this point will be more emphasized, especially that we will focus on Perret's designs in Egypt in the following section of the research.

No artist who got the chance to see what the Egyptians built 4000 years ago, ignores its effect in his way of thinking, and, thus, his work. August Perret's undated trip to Egypt certainly had an influence on his architectural and constructional theory.<sup>15</sup> Zahar recites a hypothesis that relates his reinforced concrete columns to an observation that Perret made from his hotel's window in Cairo. He claimed that the origin of Perret's columns were a grove of palm trees, that had elegant trunks, thin at the base and large at the summit.<sup>16</sup> Affirming the inspiration that Auguste got from his visit to Egypt, Bernard Champigneulle refers to Perret who says:

Nous avons hésité bien longtemps avant d'oser cette forme et c'est, en Egypte, l'aspect d'un groupe de palmiers dont les troncs lisses et nus s'élançaient du sol jusqu'à leurs palmes, à plus de vingt mètres de hauteur en grossissant toujours, qui nous a décidés. Pour passer de la forme cylindrique de la colonne à la forme rectangulaire de la poutre, nous avons interposé un tronc de pyramide à base carée avec courbe de raccordement au cylindre—ce n'est pas un chapiteau, c'est un lien, mais ce lien termine la colonne et fait d'elle, avec son gable et sa base, un individu, une personne qu'on ne peut sans mutilation allonger au raccourcir.<sup>17</sup>

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<sup>15</sup>From the following examples that show Perret's inspirations from Egyptian architecture, I assume that Perret's visits to Egypt started around the year 1922.

<sup>16</sup>"Au Caire, de la fenêtre de son hôtel, il apercevait un bosquet de palmiers. Il admirait l'élégance des troncs d'arbres fins à leur base, larges au sommet, et il songeait en même temps à la possibilité de transmettre cette forme à une colonne. Ainsi naquit l'idée de la 'colonne Perret' qui prit corps avec la colonnade du Musée des Travaux Publics." Marcel Zahar, Auguste Perret, p. 9.

<sup>17</sup>A. Perret, La Renaissance, January 1939, quoted from Bernard Champigneulle, Perret, Paris: Arts et Métiers Graphiques, 1959, pp. 79–80.



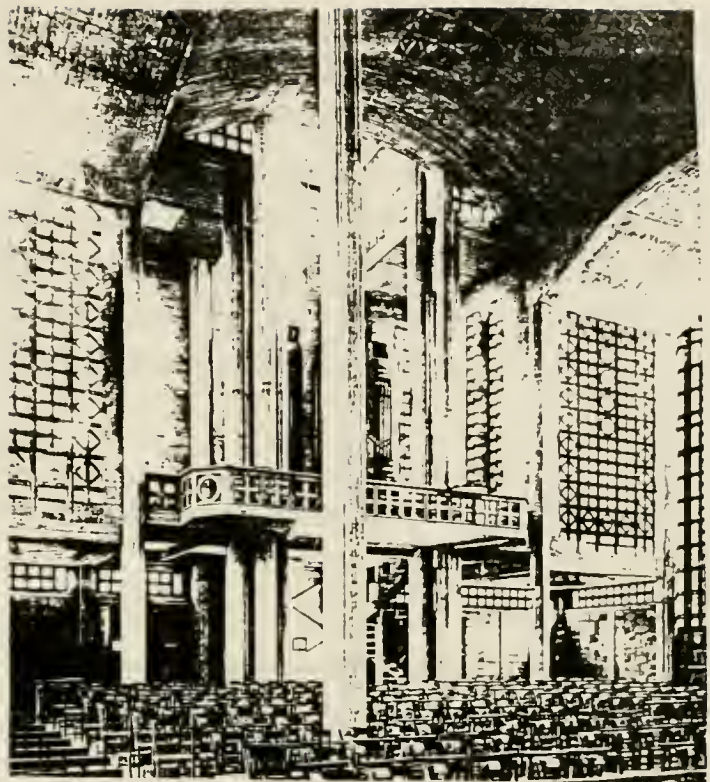
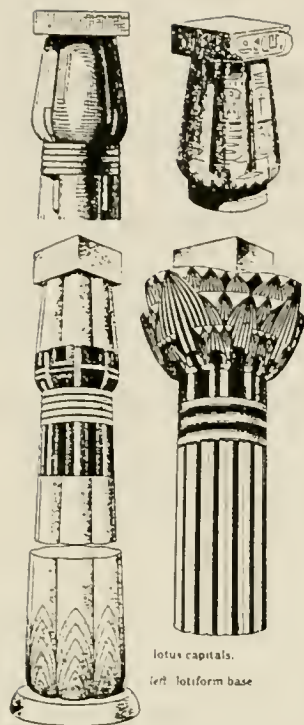


Figure (9): Egyptian lotiform column. Interior of Notre Dame de Raincy (Jamot, pl. XXIV)

The Egyptian influence on Auguste manifested in a lot of his buildings, columns details, as well as in shaping some of the bell towers that he designed. In Notre-Dame du Raincy (entry 63), 1922-1923, Auguste Perret adapted the Egyptian lotiform column, inspired from lotus buds bandage, to shape the interior columns of the central tower of the church. A. Perret, instead of using one column, used four quadruple fluted columns, having the multilevel floors acting as a "strings."<sup>18</sup> The architect's utmost depiction of his fascination with the Egyptian architecture is in his project for the Salon de Tuileries (entry 113), 1928. Perret, here, inspired with the monumentality of ancient Egyptian architecture, proposed an Egyptian temple-like entrance gate. Moreover, he repeated the pyramidal shapes throughout his design as a means of skylights.

<sup>18</sup>Paul Jamot indicates that this solution is not only an esthetic refinement, but also was economic, since the dimensions of these columns are the same of the other columns used in the church. This allowed a unification in the concrete form-work. See Paul Jamot, A. -G. Perret et L'architecture du Béton Armé, Paris: Librairie Nationale d'Art et d'Histoire, 1927, p. 53.



Perret, also referred to the shape of the Egyptian obelisks to shape his towers. He ended the tower of Sainte-Thérèse at Montmagny (entry 90), 1925, with a very distinct pyramidal shape that he never used before. Moreover, the most distinct Egyptian influence on Perret's design is seen in the columns used in the Musée des Travaux Publics (entry 197), 1937, and the external colonnade of the Hôtel de Ville at the Havre, Paris (entry 267), 1952. Here, Auguste provides an abstraction of the ancient Egyptians lotiform capital to his columns, at the exterior of both the Museum and the hotel.

### **3.3. Perret's theory and practice**

Architecture is the art of organizing space and it expresses itself through construction.

A. Perret

Auguste Perret's idea was to create an honest architecture which allowed every material used to express itself. However, he did not mean, by his construction concerns, to create an ugly building. Instead, his intention was to play with these materials, as musicians do with musical notes, in order to produce a 'singing facade'.<sup>19</sup> Consequently, to investigate Perret's architectural theory, it will be necessary to look at his building practice from both its construction techniques and its elemental components. This will be conducted through the following subheadings:

#### **3.3.1. Reinforced Concrete**

Reinforced concrete had been developed and sporadically applied for some time before Perret's arrival on the scene.<sup>20</sup> Reservoirs, aquaducts, airplane hangers, and bridges were common uses in which the material was

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<sup>19</sup>A. Perret states that if "vous voulez utiliser le fer, soit, mais montrez le matériau apparent. Faites toujours de l'architecture avec la vérité du matériau." He also said that "il faut faire chanter la façade!" Quoted from Marcel Zahar, Auguste Perret, p. 19.

<sup>20</sup>The discovery of the reinforced concrete goes back, as Raafat states, to an article written by Loudon in 1833. The interventions of Wilkinson, 1854, and Monier, 1867 elaborated Loudon's idea of a fire resistant material. Raafat also explains the role of the French engineer François Hennebique to affirm the use of the reinforced concrete in construction, 1879, and to invent the framed construction system, 1892. For a complete account on the history of the concrete invention and the reinforced concrete early technology, see Ahmed Raafat, Fan Al Imara wa Al Kharassana El Mosalaha, authorized translation of Reinforced Concrete in Architecture, New York: Reinhold Publishing Corporation, 1958.





employed. No one was yet convinced that reinforced concrete could have any architectural use or could be willingly shown.

Peter Collins identifies five general methods of using reinforced concrete structurally, by 1905: Conventional, which means that the concrete was used without any attention to the novelty of the system although its characteristics differed from those of bricks or stone; Futuristic, which made the excessive display of concrete, especially as this display produced forms never seen on earth; Skeletal, which was used to show the nature of the new material by using and emphasizing the reinforced concrete frame; Plastic, which was a mode that yielded completely to Art Nouveau doctrines; Veneered, which was to face the structure with another material, to ensure against a poor concrete finish or to guarantee against any reinforcement decay.<sup>21</sup>

The modern architects of the first generation, identified by Hitchcock, were attempting to reach a new mode of architecture that depended on the beauty of the construction materials (whether steel or reinforced concrete.) Among these architects were: Louis Sullivan, Frank Lloyd Wright in the United States; McKintosh in England; Otto Wagner and Adolf Loos in Austria; H. P. Berlage in Holland; Peter Behrens in Germany; Tony Garnier and Auguste Perret in France.<sup>22</sup>

Particularly, Auguste Perret was looking for a beautiful 'skeletal' use of the reinforced concrete applying new modes of technology. In his *Contribution à une théorie de 'architecture*, he summarizes the evolution of building materials, and emphasizes that the reinforced concrete is the authentic mode of the architecture of the twentieth century.

A l'origine, il n'est d'architecture que de charpente en bois. Pour éviter le feu, on construit en dur. Et le prestige de charpente en bois qu'on produit tout les traits jusqu'aux têtes de chevilles. A partir de ce moment, l'architecture dite classique n'est plus qu'un décor. . . Enfin voici la charpente d'acier. Puis née en France, la charpente en béton de

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<sup>21</sup>Collins, Peter. *Concrete: The Vision of a new Architecture, a study of Auguste Perret and his Precursors*. New York: Horizon Press, 1959, pp. 179-181.

<sup>22</sup>See Hitchcock, Henry-Russell. *Architecture: Nineteenth and Twentieth Centuries*, The Pelican History of Art, 1989 edition, first published in 1958, pp. 419-486.





ciment armé, prête à couvrir le monde d'une authentique architecture.<sup>23</sup>

He saw concrete as dependent on the straight lines imposed by wooden form work, and it was the interplay of horizontals and verticals that brought reinforced concrete close to classical forms. For that reason he received some criticism in saying that "he left concrete structure no more advanced than he found it and some, more recent, criticism has even suggested that he retarded its development."<sup>24</sup>

A. Perret saw architecture as a vocabulary, its words are the construction elements (columns, beams, and infill). He was always trying to determine the appropriate shape of each element separately in accordance with its functional needs, to introduce refinements and harmony into each part, and eventually to the whole composition.

### 3.3.2. Columns

Columns were an essential part of Perret's new vocabulary, because of their structural integrity and dignity, as well as the powerful rhythm that columns can provide by their ranks. Consequently, whenever convenient, Perret isolated them in space, and provided with their rhythm the dominant element of his design.

Perret tapered his columns from top to bottom. Perret designed his columns so that instead of diminishing regularly, the diminution varied to produce the curvature desired by him. Columns, Perret said, "are like timber structure, such as tables and chairs just as table legs, deriving their stability from the rigidity of the upper joint, were traditionally considered more elegant when tapered towards the bottom, so concrete columns might logically be shaped in a similar way."<sup>25</sup>

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<sup>23</sup>A. Perret, *Contribution à une théorie de l'architecture*, 1952.

<sup>24</sup>Reyner Banham, *Theory and Design in the First Machine Age*, Cambridge, Massachusetts: the MIT Press, 1960, p. 38. Banham then states that on the other hand Perret "left concrete an aesthetically acceptable material which is what it certainly was not before him, in spite of the efforts of Hennebique."

<sup>25</sup>A. Perret, quoted from Peter Collins, *Concrete: The Vision of a new Architecture*, pp. 205-206.



To give greater elegance and to take care of any inaccuracy in casting, the columns were fluted. The cement film was removed by bush-hammering the center of each face, leaving the arises untouched. This produced slight concavities by a feasible and cheaper technique than to use circular strips of planking in the form work. However, by hammering the concrete, the surface could exhibit microcracks which promotes for water entrapment and, consequently material deterioration.

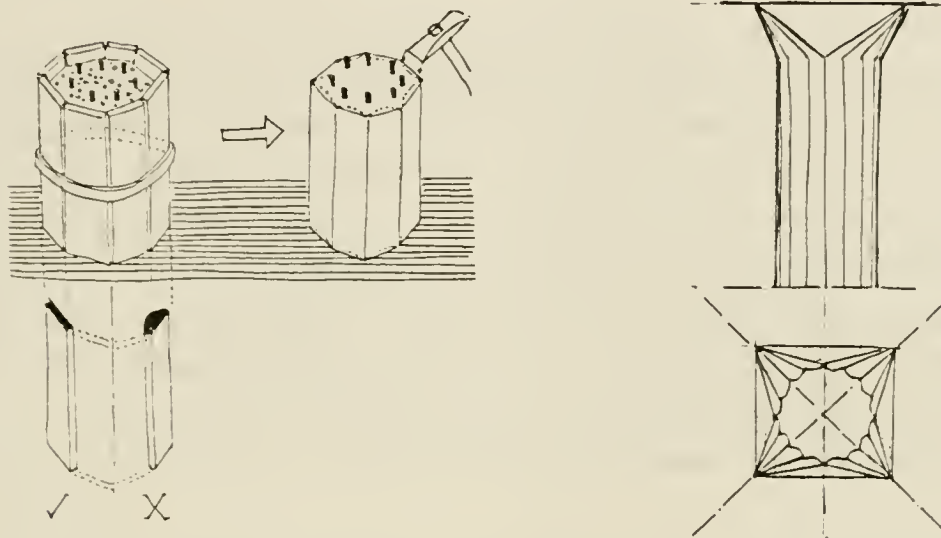


Figure (10): Auguste Perret's columns: fluting technique, capital and shaft. (by the author)

At the top of his columns, Perret experimented with some changes in order to achieve a smooth transfer between the round columns and the rectangular beams above. In his earlier work he did nothing and let the beams laid directly on the column or put a narrow decorative band. Then, he realized that he should seek logical transition from his circular columns to the square shape of beams' intersection. Perret's first attempt to achieve satisfactory transition in the Musée des Travaux Publics, 1937 (entry 197). At le Hotel de Ville, le Havre, 1952, he finally achieved a suitable solution. The transition was achieved by a series of prismatic modulations developed progressively from the phases of the polygonal shaft (entry 297). It should be noted that whenever Perret provided a capital to his column, the number of the flutes of the shaft were always dividable per 4 to coincide with the four sides of the capital.



There is no literature, as far as I reviewed, which explains Perret's reinforcements of his columns. However, Mathews points that the system of reinforcement was such that there was much more reinforcement at the top than there was at the bottom.<sup>26</sup> Following rationally the load-distribution line—dispersed loads at the beams level and concentrated load point at the bottom of the column—was probably Perret's subjective idea.

### 3.3.3. Beams

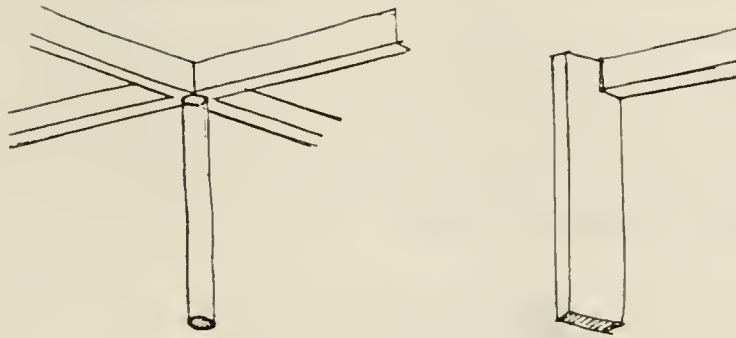
Although, it might seem structurally most efficient to vary the sections of beams whenever the spans or loads differ, it was logical to Perret to maintain a constant section because their function was approximately the same. Perret terminated his columns at the bottom of the beams, and he never let them penetrate the face of the columns, even if this involved using more concrete than necessary. Perret wanted to clearly express that it is the beams that carry the slabs and not the columns. He did this by honestly depicting that the columns are cast separately from the beams with the reinforcement sticking out, and casting the beams directly across the columns. He achieved, thus, a horizontal continuity and a visual distinction between the elements of his vocabulary.

Perret never used cantilever beams, he always employed the more simple and logical solution. He also did not agree with the installation of any technical system between beams and never covered them with a false ceiling. Again, no literature found describes Perret's reinforcement or calculation of the beams' reinforced bars.

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<sup>26</sup>Jonathan Mathews, Rational Concrete Architecture, May 1972, p. 15.






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Figure (11): Possible relations between columns and beams. (by the author)

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For both his columns and beams, Perret studied the surface treatment of their concrete. Collins, briefly states that he anxiously experimented “different aggregates and different types of bush-hammering.”<sup>27</sup> This shows that Perret was concerned, with the smallest details, to provide beauty to his new material. Moreover, he chose aggregates which are different in color, texture and size, to give an infinite number of subtle gradations in tone, luminosity and scale.

#### 3.3.4. Infill

Perret saw that the only way of expressing a non load bearing membrane was to fill the entire space between the structural supports with either a: blank wall, as in the Théâtre de l'Exposition des Arts Decoratifs, 1924 (entry 77) and Alfred Cortot concert Hall, 1928 (entry 129); glass, as in the Musée de Travaux Publics, 1937 (entry 197); or decorative brick pattern, as in most of all his Hôtel Particuliers. In the last possibility, Perret made brick, which was often plastered at this time, a beautiful material to look at.

Perret also used pre-cast concrete blocks as an infill. His first use of these blocks, as far as I know, was in the construction of Oran Cathedral, Algeria, 1902-08, designed by Albert Ballu (entry 11). However, it was not until the year 1922 that Perret started to incorporate these pre-cast blocks in his designs

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<sup>27</sup>Peter Collins, *The Doctrine of Auguste Perret*, Architectural Review, vol. 114, Aug. 1953, p. 97.





as decorative or climatic control elements in Notre Dame church at Raincy, 1922 (entry 63), and the residential complex, Grand-Quevilly, 1922 (entry 62). He, then, used the same blocks, though carrying a pyramidal design, in Gustave Aghion Hôtel Particulier, 1926 (entry 97). Perret seems to have liked this design as he repeated it in all his Egyptian buildings' designs (entry 159, 172 and 212). He also used it in the Musée des Travaux Publics, 1937 (entry 197).

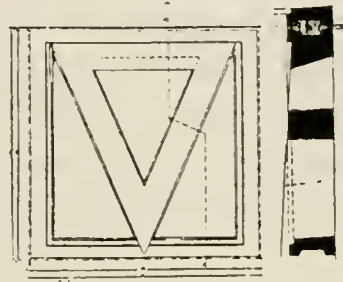


Figure (12): Detail of the pyramidal shape pre-cast units.  
(Perret, *Techniques & Architecture*, No. 1-2, October 1949, p. 87)

Perret also used blank pre-cast units as in the case of 51 Rue Raynouard, 1929 (entry 127). In both cases the blocks could be made to any dimensions required by the design. Their thinness would allow large castings to be handled with ease. Reinforcement wires could be imbedded within grooved joints and secured to the structural frames.

In Residential windows, whose frames were always pre-cast, Perret used the traditional vertical French window or porte-fenêtre which took the full height of the room to give more satisfactory gradation of light.<sup>28</sup> Perret, in order to differentiate between his infill elements, projected the window and door frames from the wall. Collins points that the projection of the window helped to house folding metal shutters within the external reveals.<sup>29</sup>

### 3.4. Steps towards modern mode of rational classicism

This section will not be a review of Auguste Perret's design approach throughout his extensive building list. This is already studied and fairly well

<sup>28</sup>For the controversy between Perret's vertical French window and Le Corbusier horizontal strip window, see Bruno Reichlin, *Une petite maison on Lake Lemau (Perret-Le Corbusier controversy)*. *Lotus International* No. 60, 1988, pp. 59-83.

<sup>29</sup>Collins, *Concrete: The Vision of a new Architecture*, 1959, p. 218.



covered.<sup>30</sup> Instead, it will be a summary of Perret's major buildings that could be considered as a turning point either in the technical use of the reinforced concrete, or the development of a rational classicism output from the new invented material.

The first building in which Auguste first introduced reinforced concrete was the Casino de Saint-Malo (entry 7), 1898-99, where the new material was used in a 18 meters beam. 25 bis rue Franklin at Paris (entry 12), 1902-03, was his first apartment building constructed out of reinforced concrete. His garage Ponthieu (entry 22), 1907-08 was his first attempt to reveal the reinforced concrete structural grid of the façade. The first attempt to introduce the reinforced concrete in a monumental building was in Perret's Théâtre des Champs-Élysées (entry 31), 1911-13.

In Notre Dame de Raincy (entry 63), 1922-23, Perret arrived at the most pure formulation of the reinforced concrete. The church was important not only for its elegant proportions and refinements but also for both its formulation of the cylindrical column articulated within a non-load-bearing envelope and its standard pre-cast concrete blocks.

Although demolished a few months after its completion, the Théâtre de l'Exposition des Arts Decoratifs (entry 77), 1924-25, expressed Perret's total understanding of the structural properties of the reinforced concrete. However, some critics consider the theater an awkward expression since the columns that articulated the blank exterior reflected Perret's preoccupation with the creation of a new mode of classicism.

Perret in the Musée des Travaux Publics (entry 197), 1937, experienced for the first time two important features that affirmed his appreciation and concern with the reinforced concrete: the top-to-bottom tapered columns, and the

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<sup>30</sup>Books that present a good review on the work of Perret could be chronologically classified in three main groups: First, the early period books that were written in late twentieth (in the middle of Perret lifecourse), for example: Paul Jamot, A.-G. Perret et L'Architecture du Béton Armé, 1927; Second, the middle period books that were written right after Perret's death, for example Ernesto Rogers, Auguste Perret, 1955, Bernard Champigneulle, Perret, 1959, Peter Collins, Concrete: The Vision of a new Architecture, a study of Auguste Perret and his Precursor, 1959; Third, the most recent books, Giovanni Fanelli & Roberto Gargiani, Auguste Perret, 1991.



glass panels infill. However, in this museum he never reached a satisfactory solution for the geometry of his columns' capitals. That did not happen before his columns' articulation in the Hôtel de Ville at Le Havre (entry 267), 1952. This shows that Perret, at the end of his career, was not only concerned with the general beauty of his concrete structures, but he was also involved in the perfection of the details.

### **3.5. Projects beyond France**

Perret has an extensive building list outside of France. He designed and built buildings in Algeria, Morocco, and Egypt. He also constructed buildings that were not designed by him in Algeria, Morocco, Turkey, England. Moreover, he proposed several projects in Algeria, Egypt, Tunisia, Lebanon, Turkey, Soviet Union and Italy that were never executed.

As he was his own contractor and he personally supervised the training of all those who worked for him, Perret would have a team-work of workmen in the countries where he built (Algeria, Morocco, Egypt). Fanelli informs us, in his Perret's building list, that Perret had an office in Boulevard Circulaire, Casablanca, 1921 (entry 57). Although this information explains how Auguste managed to build in Morocco, it proposes an unresolved question: How did the architect execute his designs in both Algeria and Egypt? And if he did not have such a team there, How did he achieved his usual remarkable accuracy without supervising the work? It could be assumed, though, that Perret trusted an architect in both countries to execute the work.

#### **3.5.1. Europe (out of France)**

Perret never designed and constructed in Europe except in France. The following two buildings are the only projects that he constructed according to another architect's design: Algeria Pavilion, designed by Albert Ballu, at the Franco-Britannique exposition, London, 1908 (entry 25); The transformation of the France embassy in Constantinople, designed by George Chedanne, Turkey, 1908-10 (entry 29)

Nevertheless, Perret proposed several projects all over Europe. The following are a list of his unerected projects proposed in Europe outside of France: the Palais des Soviets, Moscow, 1931 (entry 151), a monument for





Kemal Atatürk, Ankara, Turkey, 1939 (entry 221); Théâtre Comœdia, and Grand Théâtre for Istanbul, Turkey, 1939 (entry 228); a museum for Armando Alvares Penteado Art, San Paulo, Italy (entry 245).

### 3.5.2. Algeria

Auguste Perret had a strong relation with Algeria and the Algerian territories. Evidences of this intimate relationship is that he constructed the Algeria Pavillions in several exposition occasions: Marsillia Exposition, 1906 (entry 20), and the Franco-Britannique exposition, London, 1908 (entry 25) designed by Albert Ballu, and at the International Exposition of arts and techniques of the modern life, Paris, 1937, designed by Jacques Guiauchain (entry 202). This intimacy is also displayed with his extensive Algerian building list that he either proposed, constructed, or both. Although this list requires further studies, it will be sufficient, for the purpose of this research, to only state Perret's work their.

Perret designed and built the following: Docks à Saïda, Tiaret at Sidi-Bel-Abbès, 1907-08 (entry 23); the General Hospital for the Public Assistance, Mustapha, 1934 (entry 184); Distribution office of the U.F.F, Boulevard de Flandre, rue de Picardie, Algeria, 1936 (entry 196). He also constructed: the Oran Cathedral, designed by Albert Ballu, Oran 1902-08 (entry 11); the construction of the Office building of the General Government of Algeria, designed by Jacques Guiauchain, Algeria, 1929-35 (entry 136); the upgrading project of the boulevard Marechal-Roch, designed by Jacques Giauchain and Maurice Rotival, 1936 (entry 196); a girls' secondary school designed by Marcel Cristofle, Constantine, 1940 (entry 224); and a Jetty for the harbor of Algeria designed by U. Cassan and J. Larras, 1948 (entry 251).

Perret's designs for Algeria that remained unbuilt are the projects for the following: Theater for Oran, Oran, 1902 (entry 10); the Cité militaire, Algiers, 1932 (entry 165); the Governmental and the Agricultural Palaces, Algiers, 1933 (entry 176, 177); the Paul Iefèvre house, Boulevard Gallieni, El Biar, 1937 (entry 204); two apartments building at Ain Zeboudja park, El Biar, 1939 (entry 218) and 21 rue Desfontaines (entry 222); and a concert pavilion, Algeria, 1949 (entry 255). He also, with the collaboration of L. Coutry and L. Han, proposed a project for a Hangar, Dar el Baida, 1947 (entry 242).



### 3.5.3. Morocco

Similar to Algeria, however to a lesser extent, Perret designed and constructed several buildings in Morocco. Nevertheless, it was in Morocco that Perret expressed his finest interpretation to accommodate the foreign vernacular architecture to his Docks de Casablanca, Casablanca, 1915-16 (entry 38). The Docks de Casablanca, 1919 (entry 38) signify Perret's twofold expression: his pure expression of the thin concrete slabs (3 cm. of thickness), and the vaulted shape that Perret provided to these slabs harmonize with the Arab cities' architecture. In addition to these Docks, Perret built an office for the Perret Frères, Boulevard Circulaire, Casablanca, 1921 (entry 57), and Hamelle Shop, Route de Rabat, Casablanca, 1920-21 (entry 55). Perret also constructed the Magasins Modernes (unknown architect), Place de France, Casablanca, 1920-21 (entry 54).

### 3.5.4. Tunisia and Lebanon

Perret proposed two public buildings, that were never built, in both Tunisia and Lebanon: a project for the management office of the Société de Navigation Aérienne, Bizerte, Tunisia 1917 (entry 40); an office building, Beirut, Lebanon, 1946 (entry 240).



#### 4. Perret's designs for Egypt

That was not the end for Perret's work outside of France. The following section will be devoted for the architect's work in Egypt, where he built and proposed several buildings. A special focus, then, will be prescribed to his built Alexandrine buildings.

Auguste Perret traveled extensively in Europe, South America, and Africa. Zahar points that he visited Egypt, as well as Greece and Italy, several times. He also shows some of Perret's notes taken in the Valley of the Kings, that indicate that A. Perret was there on Thursday, 17, Friday 18, and Monday 22. Perret did not include in his notes the year or the month of his visits.<sup>31</sup> Perret had some notation on the ancient Egyptian limited use of concrete. He said:

Les Colonnes du Péristyle du Labyrinthe d'Egypt (3600 av. J.-C.) sont en béton. La Pyramide de Ninus est en béton; elle est placée sur une voûte de même composition qui est percée de petits canaux garnis de poteries par lesquels devaient s'écouler les eaux de gâchage. Mais les Egyptiens n'employaient que peu ce mode de construction...C'est aux Romains qu'il était donné de créer une architecture de béton.<sup>32</sup>

Perret designed several buildings in Egypt during the period between 1926 and 1940 in which Muhammad Ali's royal descendants; King Fuad (r. 1917-36) and King Faruq (r. 1936-52), were in control of the country.<sup>33</sup> It is also important to know that at the time, Mustafa Fahmy (founder of the Engineers' society) was the director General of the Municipality of Alexandria.<sup>34</sup>

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<sup>31</sup>Marcel Zahar, p. 7.

<sup>32</sup>Quoted from Ibid., p.8.

<sup>33</sup>King Fuad and King Farouk were the last two of the ten members of Muhammad Ali's Royal family who regulated Egypt 147 years from 1805 until 1952. The members of the royal family were: Muhammad Ali, 1805-1848; Ibrahim Pasha, April 1848-August 1848; Abbas Pasha I, 1848-1854; Said Pasha, 1854-1863; Khedive Ismail Pasha, 1863-1879; Khedive Tawfik, 1879-1892; Khedive Abbas Helmy II, 1892-1914; Sultan Hussein Kamal, 1914-1917; King Fouad I, 1917-1936; King Farouk I, 1936-1952. See Vatikiotis, The History of Egypt from Mohammed Ali to Mubarak, London 1985.

<sup>34</sup>Mustafa Fahmy was also the director General of State buildings in 1937, the Director General of the Tanzim in 1943, Chief Architect for Royal Palaces. See Mercedes Volait, and Robert Ilbert, *Neo-arabic Renaissance in Egypt, 1870-1930*, Mimar, 13, 1984, p. 33.





Unlike the Modern European Pioneers who built or proposed limited number of architectural designs for Egypt at that time, A. Perret built three buildings in Alexandria (1926, 1932, 1938 respectively,) and Awad Bey House in Cairo, 1932.<sup>35</sup> Moreover, he proposed designs for several buildings in Egypt: a Dominican Convent in Cairo, 1927, an immeuble de rapport for Henri Aghion, 1934,<sup>36</sup> and a villa for Elias Awad at Beni-Suef, 1946.<sup>37</sup>

Apparently, no theories have been proposed by art historians to explain the relationship between Egypt and A. Perret. Three things could explain this manner: Perret could have been introduced to one of the several Egyptian architects commissioned to Paris by the Minister of the public affairs, Public Building Service section,<sup>38</sup> during his duration of study there (1891-1901); second, Perret designed the Arakel Nasar Bey house (entry 161) for an Egyptian client, 75 rue du Janvier, Les Quatre Vents Hill, Paris in 1932, and probably got commissions in Egypt through his client;<sup>39</sup> third, there were a lot of French families who lived in Alexandria at that time, and a direct connection between these families and A. Perret could be assumed.<sup>40</sup> In

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<sup>35</sup>Historians, for example Fanelli and Collins, assumed that 1932's and 1938's Alexandrine buildings were never been executed. However, a visit to their site reveals that the two buildings exist, and that both were constructed more or less according to Perret's designs. Perret's Alexandrine buildings will be carefully examined in the following section of this study.

<sup>36</sup>Fanelli in his Perret's building list provides the address of that project: "Rue Ramleh et d'Aboukir, Alessandria d'Egitto." Fanelli, Auguste Perret, p. 192. After a careful research on the names of the streets in Alexandria at that time, I conclude that no particular address corresponds with Fanelli's. Consequently, it was impossible for me to check if this building had been built or kept in the state of drawings as Fanelli suggests.

<sup>37</sup>See *Ibid.*, p. 194.

<sup>38</sup>From 1908 to 1931, the architectural scholar missions sent by the Minister of the public affairs, Public Building Service section: al-maslaha al-mabani al-amiriyya, were 44. 28 of them were sent to France (Ecole National Supérieure des Arts Décoratifs, and Ecole National Supérieur des Beaux Arts.) In addition Mustafa Pacha Fahmy (1886-1972) head of the Public Building Service Section got his diploma from ENPC (Ecole des Ponts et Chaussées) and encouraged scholar mission to the Beaux Arts of Paris. See Mercedes Volait, L'architecture Moderne en Egypte et le Revue El Emara 1939-59, CEDEJ, Cairo, 1989, pp. 22-36, and Muhammad 'Alwy 'Abd al Hadi, A research and a case study in the Administration of Educational Missions program in Egypt from 1813 to 1955, PhD, Cairo, 1956.

<sup>39</sup>For the E and Q Khan's home designed by A. Perret, 1932, see Marie-Pierre Toll, *Where Beauty is not a luxury*, in House & Garden 156: 130-9, September 1984.

<sup>40</sup>The result of the Census of 1917 showed a total population of 444,617. of which 84,706 were non-Egyptians. French population was 8,556. That means that 10% of the non-Egyptians were French. For a complete account on the 1897, 1907, 1917 and 1927 census see Robert Ilbert, Alexandria: Espace et Société 1830-1930, a Ph D dissertation presented to E.H.E.S.S., Paris, January 1990.





addition to these three assumptions a forth hypothesis arises knowing that Gustave Aghion, whose villa was Perret's first commission in Egypt, was an important architect practicing in Alexandria at that time.<sup>41</sup> Moreover, Volait states that Gustave Aghion is an "alexandrin de naissance, formé aux Baux-Arts de Paris (promotion 1919)."<sup>42</sup> A possible link between the two architects could have taken place during their education at the Beaux-Art in France, or their profession practice afterwards.

As it was mentioned before, the study will focus on Perret's three buildings built in Alexandria. In order to do so, several visits to Alexandria were conducted in the summer of both 1992, and 1993. These visits enabled me to investigate the extent to which these building correspond to Perret's designs, and their actual condition today, as well. However, it should be noted, as it was mentioned in the introduction, that it was not possible for me to get close to the buildings, or to enter them because of some political disturbance at the moment in Egypt, and especially because of the existence of the Egyptian Intelligence Department building in the same district where all of Perret's buildings exist. Nevertheless, the information and the photographs that could be gathered were sufficient to direct the research. It should also be added that a closer investigation, interior analysis, and interviews with the owners could open new sights, or might nullify some hypothesis that could be mistaken during my distant investigations.

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<sup>41</sup>Gustave Aghion designed the ophthalmologic Hospital in the 1920's or 30's, sponsored by I. Adah. This notation is mentioned, without references, in Mohamad Fouad Awad's paper *Italy in Alexandria-Egypt*, presented to the Annual International Symposium of the Presence of Italy in the Architecture and the Urbanism of the Mediterranean Musulman Countries 1869-1990, University of Rome, October 1990, p. 14.

<sup>42</sup>Mercedes Volait, *La Communauté Italienne et ses Ediles*, in La Revue de L'Occident Musulman et de la Méditerranée; Alexandrie entre deux mondes, no: 46, fourth trimester, 1987, pp. 148.





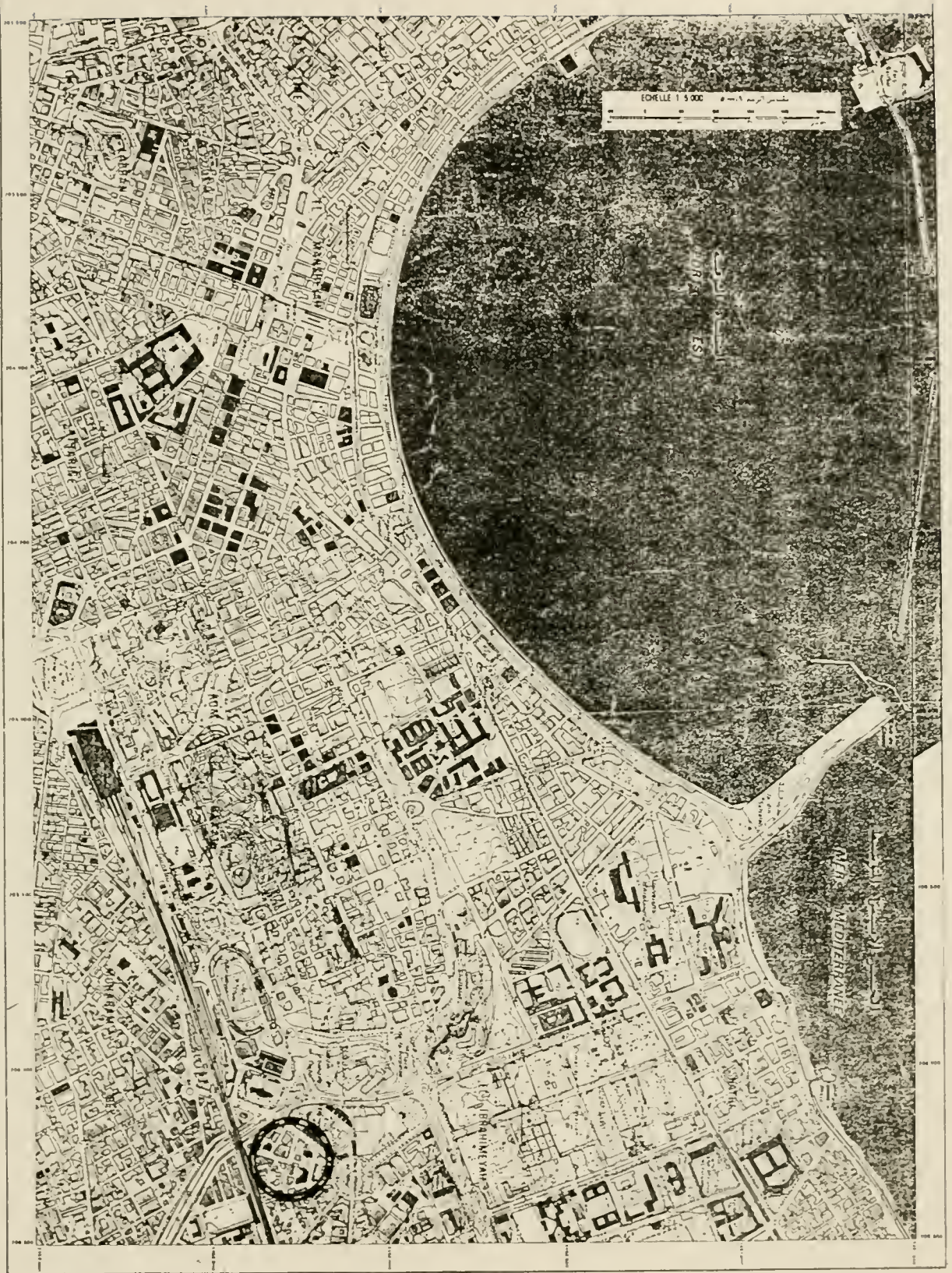


Figure (13): Downtown Alexandria, aerospace photograph, April 1977, by S.F.F-I.G.N (France), reduced from original scale 1:5000, Egyptian Cartographic Department, Al-Manchia, Alexandria. Note that Perret buildings are circled at the lower left corner. Also note that the north direction is towards the right.







Figure (14): The three Perret's building in Alexandria. (Map extracted from the detailed Maps of Alexandria, April 1935, original scale 1:500, Egyptian Cartographic Department, Al-Manchia, Alexandria). Note that the third building did not yet exist.





#### 4.1. Hôtel Particulier G. Aghion, 1926

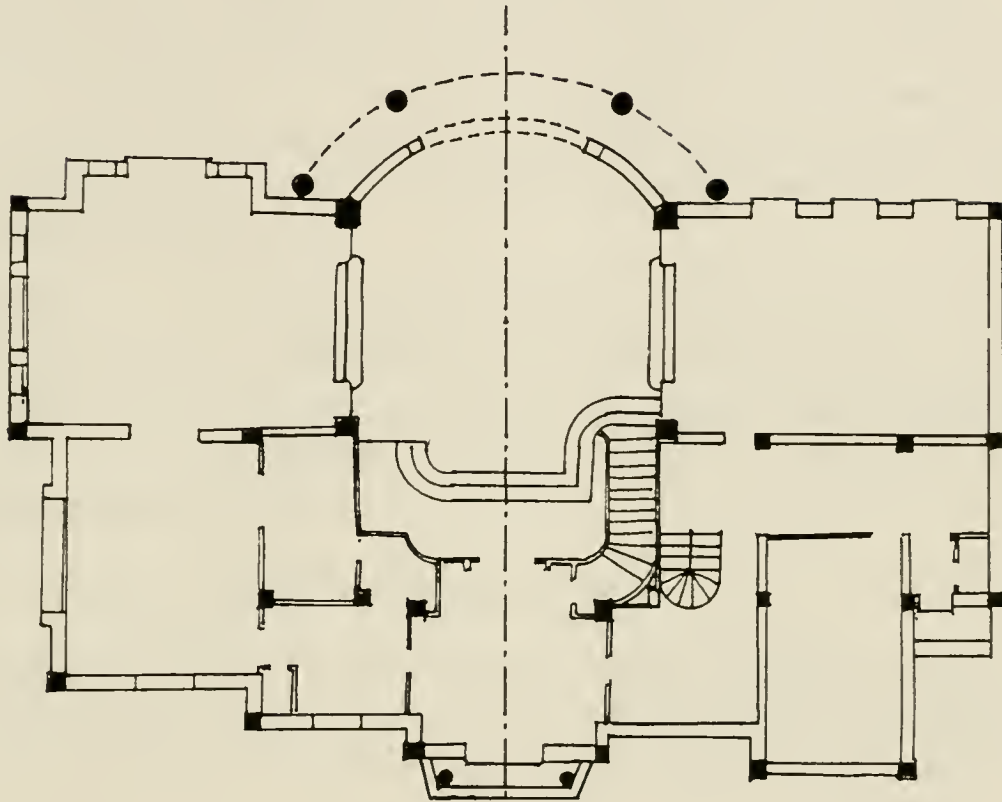


Figure (15): Villa Aghion. Ground floor plan as executed. (by the author, scale 1:200)

This building is the only structure built by Perret in Alexandria that attracted some attention from architectural historians. In fact, it is the only building among Perret's work in Egypt with a published photograph.<sup>43</sup> For all Perret's other Egyptian structures, historians were content to mention them or

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<sup>43</sup>A photograph of this villa was first published in Auguste Perret, (Noted by Marcel Mayer). *A. & G. Perret; 24 Phototypies, Les Albums D'Art Druet XVI*, Paris: Librairie de France, 1928 plate 16. Mercedes Volait used the same photograph in his Introduction's cover of her book *L'Architecture Moderne en Egypte et le Revue El Emara 1939-59*, CEDEJ, Cairo 1989, p. 7. No other photographs were published of any of Perret's buildings in Egypt.



occasionally show their drawings.<sup>44</sup> In fact, all Perret's designs in Egypt, with the exception of this villa and perhaps villa Awad Bey in Cairo, were assumed to be unbuilt -which is not true.

Gustave, the villa's original owner, was a member of Aghion family which was among the so-called Jewish aristocracy who settled in Alexandria. The Aghion family owned large estates and were involved in the cotton industry as well as in other major enterprises.<sup>45</sup> Gustave was born in Alexandria 1881. He graduated from the Beaux Arts, 1919, and practiced as an architect in Alexandria. He was one of the wealthiest members of his family. He owned in 1948 10,000 faddan.<sup>46</sup>

Located in a corner block in Wabour El Maya, a nineteenth-century European district, the villa is surrounded by: Rue Saurès from the north side; Rue Mansha from the west side; the Immeuble de rapport Edward Aghion from the east side; and three other properties, which are now high-rise apartment buildings, from the south side.

#### 4.1.1. Hôtel Particulier versus Palladian Villa

The French expression 'Hôtel particulier' is applied to identify a specific social level of habitation. Guadet classifies these different levels by arranging them in the following order: chambre, appartement, maison, hôtel, palais.<sup>47</sup> The

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<sup>44</sup>For Hôtel Particulier G. Aghion, 1926, the following drawings have been published: a drawing of Perret's landscape design that shows the ground floor arrangement of the plan, in *L'architecture d'Aujourd'hui* no. 4, April, 1937, p. 51; First floor plan (its arrangement does not correspond with the previous ground floor plan), a longitudinal section, the entrance elevation (north-west), and the porch façade (south-east) were published in Giovanni Fanelli & Roberto Gargiani, *Auguste Perret*, 1991, fig. 130-133. The latter drawings, Fanelli stated, are dated to February 1926.

<sup>45</sup>Most of the Jews in the turn of the century were situated in Alexandria and Cairo. Alexandria was the seat of the Jewish aristocracy. It was considered the best organized of all Jewish communities in Egypt. "Among the many families belonging to this stratum were the Aghions, the Toriels, the Smouhas, and the de Menascas." See Michael Laskier, *The Jews of Egypt*, New York University Press, 1920-1970, p. 47. After the reign of Muhammad Ali, the Aghions remained prosperous as they were merchants involved in the European trade, or money changers and moneylenders. See Gudrun Krämer, *The Jews in Modern Egypt*, 1914-1952, University of Washington Press, 1989, p. 37, 39 and 79.

<sup>46</sup>Faddan is an unit that express area. One faddan equals 4200 square meters. Gustave's properties, then, were 42,000,000 m<sup>2</sup>. See Gudrun Krämer, *The Jews in Modern Egypt*, 1914-1952, University of Washington Press, 1989, p. 247, note 22.

<sup>47</sup>Guadet, J. *Eléments et Théorie de l'Architecture*, volumes II p. 167.



dictionary meaning of the term is town-house, private residence or a mansion.<sup>48</sup> During my description of the building, I will use the term 'villa' as it is the closest English word that express the meaning of a French 'Hôtel particulier'.

This villa is an example of the Palladian villas imported to Egypt in the second half of the nineteenth century.<sup>49</sup> It should be noted that 'Palladian' typology of villas has different meanings, depending on cultural definition of the term. For example, the American perception of a Palladian villa is one where a classical porch projects out of a temple-like building. For Italians, it is the country house in which a family spends its vacations. However, for Egyptians, the 'Palladian' villa means simply a detached house, the notion of which opposes the traditional dense pattern of eighteenth century Arab villages.

Gustave Aghion's villa could be described as 'Palladian villa', not only for being a freestanding structure, but also because it follows Palladio's description of villas; it contains a central hall accentuated by the projection of a terrace flanked by two sets of rooms. Perret could have been inspired by the same Palladian style that was exported to France from Italy in the eighteenth century. An example of Palladian French pattern is the 18th century château de Champs whose plan was published in Guadet's *Eléments et Théories d'Architecture*.<sup>50</sup> In addition to Aghion's villa, Perret follows this central plan design in Awad Bey villa, Cairo, 1932.

Following the French Palladian pattern, Perret not only shows the social prestige of his clients, adopting the symmetric arrangement of the central-hall plan, but also retains Egyptian traditional ideas on family privacy, structure, and guest reception. In both cases, Perret respected Egyptian identity following a foreign building system.

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<sup>48</sup>See The New Cassel's French Dictionary for a complete account of the term 'Hôtel'.

<sup>49</sup>Khaled Asfour, *Cairene traditions inside Palladian villas*, Traditional Dwellings and Settlements Review, vol. IV, No. 11, Spring 1993, pp. 39-50. Asfour also, in this article, discusses the reasons upon which this building type imported to Egypt. Perret's extreme expression of the Palladian concept of villas is inferred in his design for Ata-Turk monument, Turkey, 1939. For the Palladian type of villas, see chap. III *Of the designs of town-houses*, Andrea Palladio: *The Four Books of Architecture*, Dover: New York, 1965, pp. 39-42.

<sup>50</sup>Guadet, *Eléments et Théories d'Architecture*, vol. II, p. 44.





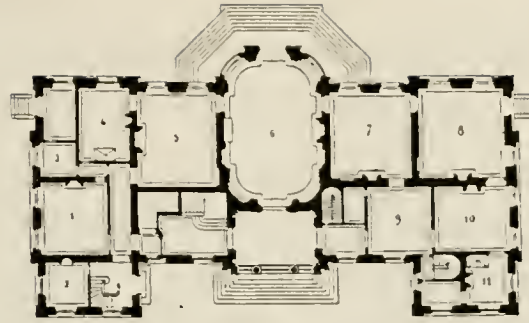


Figure (16): Château de Champs, 18th century. Extracted from Guadet's *Eléments et Théories d'Architecture*, volume II, p. 44. A comparison between this plan and Gustave Aghion's reveals a similarity in plan organization.

#### 4.1.2. *Haramlek* and *Salamlek* in Aghion's villa

Perret's understanding of the social situation in Egypt, and his refusal to alter the Palladian central hall plan, resulted in the separation of the central hall from the *salamlek* (an Arabic term that identifies the reception hall for male non-relatives.)<sup>51</sup> This was reflected in Perret's introduction of two small separate structures that he designed on the west and north side of the villa. These small rooms allow the owner of the house to meet casual friends away from the *haram* of the house (*haram* is an Arabic term that identifies the intimate spaces of a building, where only few close friends were allowed). It is not clear whether or not Perret followed the same concept in Awad Bey's villa. Since there is no published landscape design of it, the existence of the *salamlek* rooms can not be assured.

#### 4.1.3. Perret's contemporary designs

Contemporary with the design of Aghion's villa, Auguste Perret did not design any significant buildings. However, the four preceding years represent one of the most important developments of his career; namely his use of reinforced concrete in Notre Dame de Raincy (entry 63), 1922–1924. Collins points to the importance of this work not only for its elegant proportions and refinement but also for its formulation of cylindrical columns articulated within a non-load-bearing envelope. Perret's use of the pre-cast concrete

<sup>51</sup>Asfour talked about the evolution of the *salamlek* space after the mid nineteenth century, and its influence on the design of the detached houses in Cairo. Ibid., pp. 43-49.





bricks which contain geometric apertures for stained glass, is notable and original. He later used the same blocks, though modifying their design to pyramidal shape, in Gustave Aghion villa.

One of Perret's awkward external expressions, as Collins describes it, was erected in 1925 in the Exposition de Arts Decoratifs (Theatre, and Albert Levy Pavillion), Paris (entries 77 and 78). Collins states that the expression remained awkward because of Perret's occupation with the creation of new 'rational-classical' style, by articulating the blank facade with redundant columns.

In addition to Villa Aghion, 1926, Perret built several other buildings: Cassandre House, Versailles; Veret House, Noyon, France; Chana Orloff House, rue de la Tombe-Issoire, Paris (entry 95). He experimented with different kinds of infill materials in these buildings. He also proposed a design for Joan of Arc basilica, Paris (entry 96).

It should also be noted that a year later, in 1927, he proposed a design for the Dominican Convent, Cairo.<sup>52</sup> No information, as far as I know, is published about this project.

#### 4.1.4. Architectural Description

The Gustave Aghion villa consists of two main floors: the ground floor, approximately 4.80 m. high; and the first floor, approximately 3.6 m. high. An additional second floor was originally added in a limited floor area, to house the servants. Housing the servants in the upper floor of the building was a European tradition imported to Alexandria in the late nineteenth century.

Being higher than the first floor, the ground floor is sometimes divided with a mezzanine, especially in the entrance bay and its two adjacent structural bays. Perret was not ashamed to express this division in the exterior. Consequently beside his full floor-high French windows, he introduced the mezzanine short ones. Perret's solution of the façade was not awkward. In

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<sup>52</sup>Peter Collins, *Perret, Auguste*, in *Contemporary Architects*, Ann Lee Morgan and Colin Naylor (editors), second ed., St. James Press: Chicago, pp. 691–693.



contrary, his introduction of different scales, heights, and materials recalls his idea of a 'singing façade' by 'playing' different musical notes.



Figure (17): Villa Aghion, the North-Western entrance facade. (Photographed by the author)

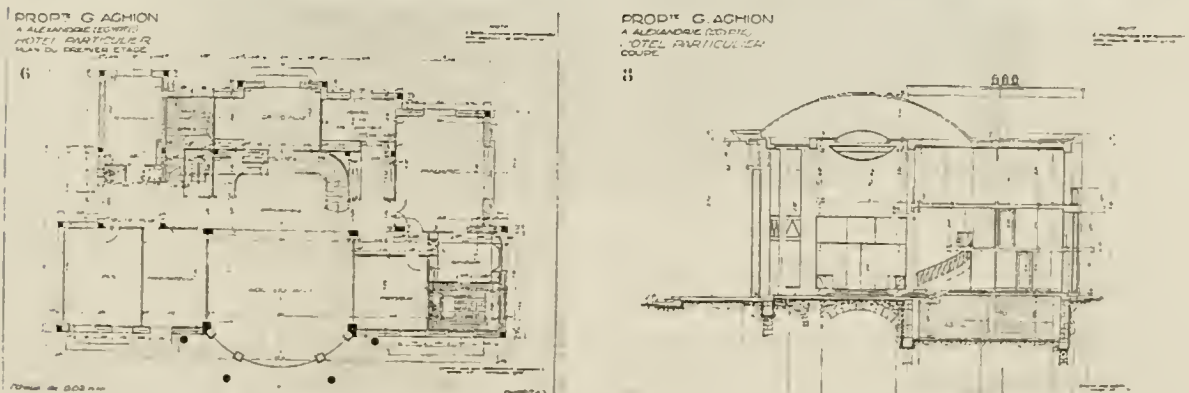


Figure (18): Villa Aghion, plan and longitudinal section. (Fanelli, fig 133)

A careful examination of the longitudinal section of the building, one can perceive that Perret added a basement floor in a limited floor area of the house. Since it was not available for me to enter the house, neither the existence of the basement nor its use could be checked. However, the external





small rectangular windows, below the ground floor level of the north-west façade, affirms its existence, and suggests storage use of the space.

Perret, in order to differentiate between his architectural elements, designed three levels of projection: the columns, the beams, and the infill. His projection of the columns over the beams was aesthetic more than structural in order to emphasize verticality of the building. A proof of this expression is the uppermost and the lowermost beams that project over the columns and create, with the upper cornice a continuous band around the building. Additional nonfunctional elements that Perret added are the two columns that articulated the entrance gate of the west façade. Being not structural, these columns recall Perret's approach to articulate the blank façade on the Théâtre de l'Exposition des Arts Decoratifs (entry 77), 1924-25.



Figure (19): Villa Aghion, west elevation. Note the two columns at the entrance gate. Also note the brick work widow frames.

Perret's drawings of the house lack the representation of the infill material. However, a marvelous brick-work pattern framed by unfinished concrete structural members, attracts the attention of site visitors. It seems that Perret not yet sure or comfortable with the beauty of concrete, which he relegated to a structural frame only. He did this by trying to attract the attention of the observer to the highly ornamental brick-work, away from the concrete construction material. In addition, the fascination of the architect with the





bricks made him to choose it as the window-frame material in this villa. This contrasts with Perret's typical usage of pre-cast concrete window-frame.



Figure (20): Villa Aghion, west side, the separate structure at the entrance gate used as *salamlek*. Note the marvelous brick-work and its reinforced concrete frame.

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Perret provided two color schemes to Villa Aghion using gray uncovered concrete as structure elements and red bricks as an infill material. In choosing gray for the uncovered concrete, Perret introduced a new color scheme to Wabour El Maya's environment. However, it seems that he did not want to enforce this new scheme on the district. He incorporated, thus, red bricks, knowing that the latter were the traditional building material in Egypt used in early twentieth century. Perret, though, presented a new aesthetic value using this material in a decorative manner. Of course, decorative red bricks were not alien in contemporary Egyptian architecture, where different coloration of bricks were used to set up decorative geometrical pattern. This type of decoration was common in Wabour El Maya, and could be exemplified by the villa on the corner of Manasha and Pasteur street. Nevertheless, Perret did not rely on the coloration of the brick units to set up his pattern. Instead, he used a fairly homogenous red-color bricks throughout the building to achieve his pattern.

Apart from Perret's unfamiliar representation of the red-bricks in Aghion's villa, his ornamental use of the material differed, I think, from the Egyptian traditional techniques in two additional viewpoints. First, he used exotic



brick dimensions (approximately 56 x 24 x 8 cm.) that opposed with the 24 x 12 x 6 cm's traditional brick units. Perret was trying, I assume, to set up a certain scale to the building by manipulating the proportion of bricks. Second, Perret introduced a wide mortar joints between the brick units—joints are equal to the thickness of the brick). I think that Perret was trying to achieve a certain coloration conjunction between the gray concrete structural members and the joints of the red bricks infill. The wide grayish mortar joints were Perret's approach to achieve this connection.

Perret, as far as I know, never used red bricks as a decorative element before Aghion's building and perhaps its contemporary Maison Chana Orloff (entry 95). However, he adopted this trend later in several residential buildings, for example in Maison Muter 1928-29 (entry 116) and in Maison Gordine, 1929 (entry 125).

#### 4.1.5. Perret's design as executed

A comparison between the drawings that have been published in Fanelli's book, the landscape design drawing published in the *Architecture d'Aujourd'hui*, and the existing building reveals the following:

- a) Auguste Perret had intention to flute the circular columns of both the entrance gate of the west side of the building (2 columns) and the semi-round porch of the east side. This intention could be read from his elevation drawings. Whether or not his design was executed is not clear. What is left now are smooth columns, though a reminiscence of radial divisions can be perceived. These divisions could be the result of the wooden form work or a later refill of Perret's flutes after the columns had undergone, I assume, deterioration. I tend to agree with the first suggestion that these columns were never fluted, especially because the photograph of the semi-rounded porch taken right after the completion of the building, published in Marcel Mayer album,<sup>53</sup> shows smooth circular shafts.

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<sup>53</sup>Auguste Perret (Noted by Marcel Mayer). *A. & G. Perret; 24 Phototypies, Les Albums D'Art Druet XVI*, Paris: Librairie de France, 1928.



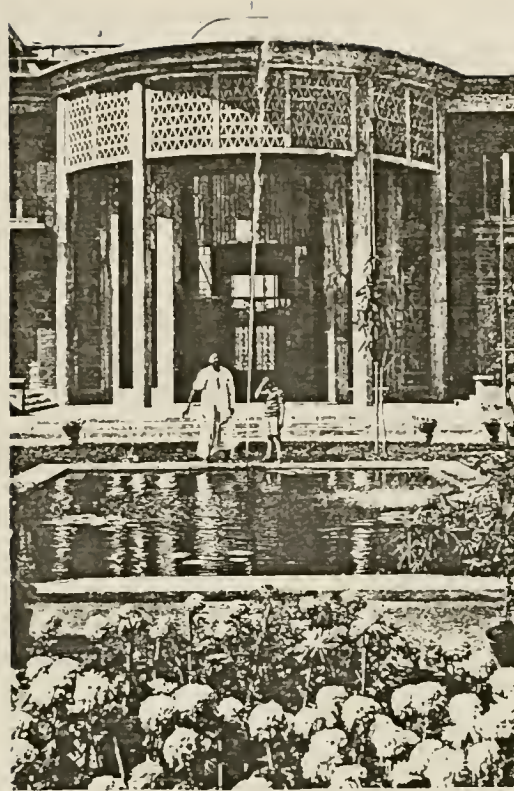


Figure (21): Villa Aghion, courtyard , right after its completion (from Marcel Mayar, 1928)

- b) Perret's drawings for the villa reveal that the architect designed simple steel bar parapets for the openings and the balconies of the entrance elevation (west side). This simple design is interrupted with pyramidal shaped bars that could either express Egyptian inspiration, or the first letter of the owner's family name (Aghion).<sup>54</sup> It could also play both roles. However, right above the entrance door, Perret drew a distinctive steel bar decorative motive that carry the first two letters of the owner's name (G & A for Gustave Aghion). In the opposite side of the building (east elevation), Perret proposed different kinds of parapets that are consisted with the same reinforced concrete pre-cast units used as sun-breakers in the semi-rounded porch. Perret was trying to provide a harmonious composition for each elevation. Unfortunately, neither of Perret's suggestions were executed according to his design. Instead, an Egyptian Lotiform steel bar design was chosen for both the parapet and the steel

<sup>54</sup>Perret seems to have liked this triangular design and adapted it in all his concrete precast units that he used in his Egyptian buildings later. Besides that, he uses the same design in his Musée de Travaux Public, 1937, Place d'Iéna, Paris.





entrance doors. The only pyramidal shape (or A letter shape), which was executed, are these three steel bar bands found in the porch façade openings.



Figure (22): Villa Aghion, Eastern facade, Western facade. (Fanelli, fig. 130-131)

- c) Although the ground floor plans of the villa, published in *l'Architecture d'Aujourd'hui*, 1937, and the first floor plan published in Fanelli's book, 1991, seem constant in their outline, there are major differences in the interior arrangement of the spaces. A closer comparison between these two drawings reveals that the main staircase location that leads to the first





floor had been altered. Since I did not have the chance to enter the building, I interrogated some friends and relatives of the new owner, and they all affirm that the interior arrangement of spaces coincides with the one published in the *Architecture d'Aujourd'hui*, 1937.<sup>55</sup>

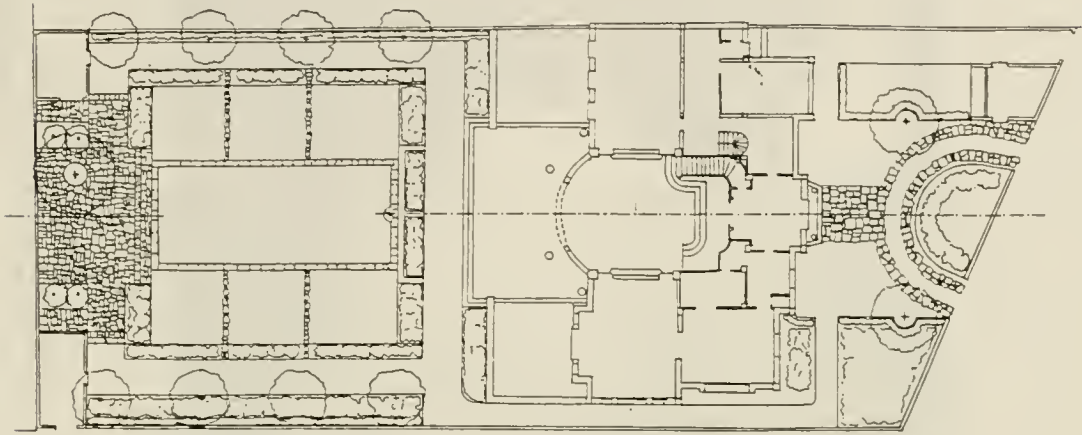


Figure (23): A reconstructed drawing of Perret's landscape design of villa Aghion, published in *L'architecture d'Aujourd'hui*, April 1937. (by the author)

- d) Based on Perret's landscape design and the early photograph of the courtyard, one can perceive that there was a rectangular water fountain in the middle of the garden. It is not clear if this water source was used as a swimming pool or not. However, its dimensions (16.8 x 7.6 m.) suggest a good possibility for swimming activities. Perret located this pool and its water jet axial to the porch, and consequently to the main entrance of the house. Perret by doing so, created not only a climatic refinement, but also pleasant effect for the visitor of the house. Unfortunately, the pool has been filled with earth and planted over. However, the recent photograph taken of the garden, shows that the borders of that pool still exist.

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<sup>55</sup>The new owner of the villa is a member of Shamashrgui family. I would like to express my gratitude to my colleague Yasser Aref, assistant teacher at the University of Monofia, Egypt, to drive my attention about the differences in the two plans' arrangement, and to affirm, since he visited the interior, the *Architecture d'Aujourd'hui*'s one.





Figure (24): Villa Aghion, existing condition of the courtyard. (photographed by the author)

#### 4.1.6. Villa Aghion and Clerget's description

Although Clerget came out with his description ten years after the erection of villa Aghion, the villa accords exactly with what Clerget saw in 1934 to be the perfect example of Egyptian architecture. The "style moderne" and the "style arabe, avec bassin, fontaines, cours" that Clerget mentioned are perfectly expressed by Perret in both his architectural expressions using modern materials, and his concern with the social life in his plan's spatial organization. Perret's usage of patterned bricks as an infill material emphasizes Clerget's "usage de la brique rouge apparente dans un style Tudor; revêtements divers de belle brique". Moreover, on the details level, Perret was concerned—by his usage of the pyramidal shape concrete blocks—to show what Clerget describes later as "emprunts modérés et judicieux à l'architecture pharaonique." Finally, Perret did not forget, by inspiring the plan arrangement from the Palais de Bois, his French background as Clerget



states that "courant à l'étage supérieur: style Renaissance ou Louis XVI, sans recherche pompeuse."<sup>56</sup>

From this total similarity between Perret's design for Gustave Aghion's villa and Clerget description, it seems to me that Clerget based his ideas upon seeing this building, and according to him this villa was perfect Egyptian architecture erected in the 1930's and 40's.



Figure (25): Villa Aghion, the semi round porch of the eastern facade. Note the precast concrete blocks installed between two vertical elements. (photographed by the author)

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<sup>56</sup>Clerget, Le Caire, vol. I, Cairo, 1934, p. 345.





#### 4.2. Two 'Immeubles de rapport': Edward Aghion 1932,<sup>57</sup> and Aly Yehia Bey, 1938-39

In addition to villa Aghion, Perret designed two apartment buildings in Alexandria, located in Wabour El Maya district—the same nineteenth century district where villa Aghion exists. As it was mentioned before, these buildings were assumed, by historians who never visited their sites, to be unbuilt. The first is the six floor high Edward Aghion Immeuble de rapport built in 1932 for Edward, one of the same Aghion family that was previously described. The second is the five floor high Aly Yehia Bey Immeuble de rapport, built in 1938-39. The owner of the latter building was a judge in the Egyptian court, as one of the present residents of the building informed me.

This section will analyze some common issues for both buildings, for example, the definition of the term Immeuble de rapport, the evaluation of the urbanistic integration in both cases and Perret's manipulation of 1923's building regulations. A detailed description will be undertaken separately for each.

##### *4.2.1. Hôtel Particulier versus Immeuble de rapport*

Before describing Perret's apartment buildings in Alexandria, it is important to get an historic account of the development of apartment buildings in early twentieth century. In an article published in *L'Egypte Contemporaine*, 1931, Minost provides an interesting study on the built properties in Egypt during the period between 1919 and 1930. Based on the Egyptian *Annuaire Statistique*, the author reveals some useful statistic on buildings and their growth during this period, indicating the amount of investment in the building construction. Comparing between the years 1920-21 and 1927-28, the study shows that the numbers of buildings built in Alexandria increased by 49%, and their lease value doubled. The same statistics applied to Cairo during the same period of time, indicated that the numbers of buildings increased by only 21%, and their lease value augmented by 30%. These

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<sup>57</sup>The French term 'Immeuble' means a type of habitation that consists of several floors, and the expression 'Maison de rapport' means *immeuble dont la location procure des revenus au propriétaire* (a flat whose revenue goes to its owner).



numbers show that the building construction in Alexandria was a major type of investment, and they also explain the rapid growth that the city exhibited at the time.<sup>58</sup>

Unfortunately, the building statistics at the time did not include the nationality of the building owner, so one can study the percentage of non-Egyptian owners, and locate their conglomeration within the urban fabric of the city. However, Minost, without showing his source of information, provides a percentage scheme of owner's nationalities: 72% Egyptians, and 28% foreigners. He also added that the average cost of foreigners' buildings was higher than those of Egyptians': 17.000 L.E. for foreigners' and 6.800 L.E. for Egyptians'. Moreover Minost indicates that the foreigners tended to built more apartment buildings 'immeuble de rapport' than villas (*Hôtel Particulier*), and that the opposite case was true for Egyptians.<sup>59</sup>

Clerget opposed the rising of these buildings, because, he says, they were:

. . . bâtiment misérables, sans styles mal construits, minces comme du carton, serres chaudes en été, froids en hiver, défis au bon sens dans ce climat à forts écarts de température; gros blocs massifs de cinq, six, sept et même huit étages, énormes carcasses de fer. . . Les architectes se plaignent que tout doit être considéré en fonction de nombre maximum d'appartement, des dimensions exigues de ceux-ci, pour louer plus facilement, surtout le temps de crise.<sup>60</sup>

Wealthy Egyptians, on the other hand, were fascinated with the Italian Palladian villa which opposed with the dense pattern of their cities at the time. Consequently, they started to built their new houses outside the cities. However Europeans, considering their stay in Egypt as a temporary stage, invested their money erecting apartment buildings and leasing the maximum number of flats. They were aware with the shortage inhabitation in Egypt in general, and Alexandria in particular, especially after the twofold effect of the world war on the country: demolition of many parts of the old

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<sup>58</sup>Minost, *Etudes Economiques et Juridiques; Essai sur la Propriété bâtie de l'Egypte, L'Egypte Contemporaine*, 1931, p. 686.

<sup>59</sup>*Ibid.*, p. 690.

<sup>60</sup>Marcel Clerget, *Le Caire*, vol. I, Cairo, 1934, p. 325.



dense cities, and the interim interruption in the construction work during the war.



Figure (26): South block of the Immobilia building, the corner of Cherif and Qasr al-Nil streets, Cairo. Designed in 1937, completed in 1940. (Volait, p. 63)

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The higher the building the more apartments it carried, and consequently, the more economic benefits. The lack of building regulations that limit the building heights aggravated the situation. It was not before the erection of the first skyscraper in Cairo, the Immobilia bloc in Cairo, 1940,<sup>61</sup> that special concerns were directed to limit the building heights. Consequently, law No. 51 on construction and 52 on housing were generated to limit it to 30 meters.

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<sup>61</sup>The 18 floors' Immobilia building, 70 meters height, is considered the first skyscraper in Cairo, and in Egypt. Max Edret and Gaston Rossi, architects, presented their design in 1937. The work begun in February 1938, and completed in January 1940. See Volait, *L'Architecture Moderne en Egypte et le Revue El Emara* 1939-59, CEDEJ. Cairo 1989, pp. 62-63.





4.2.2. 'Immeuble de rapport': Edward Aghion, Rue Pasteur, Rue Saurès, 1932 or 1933

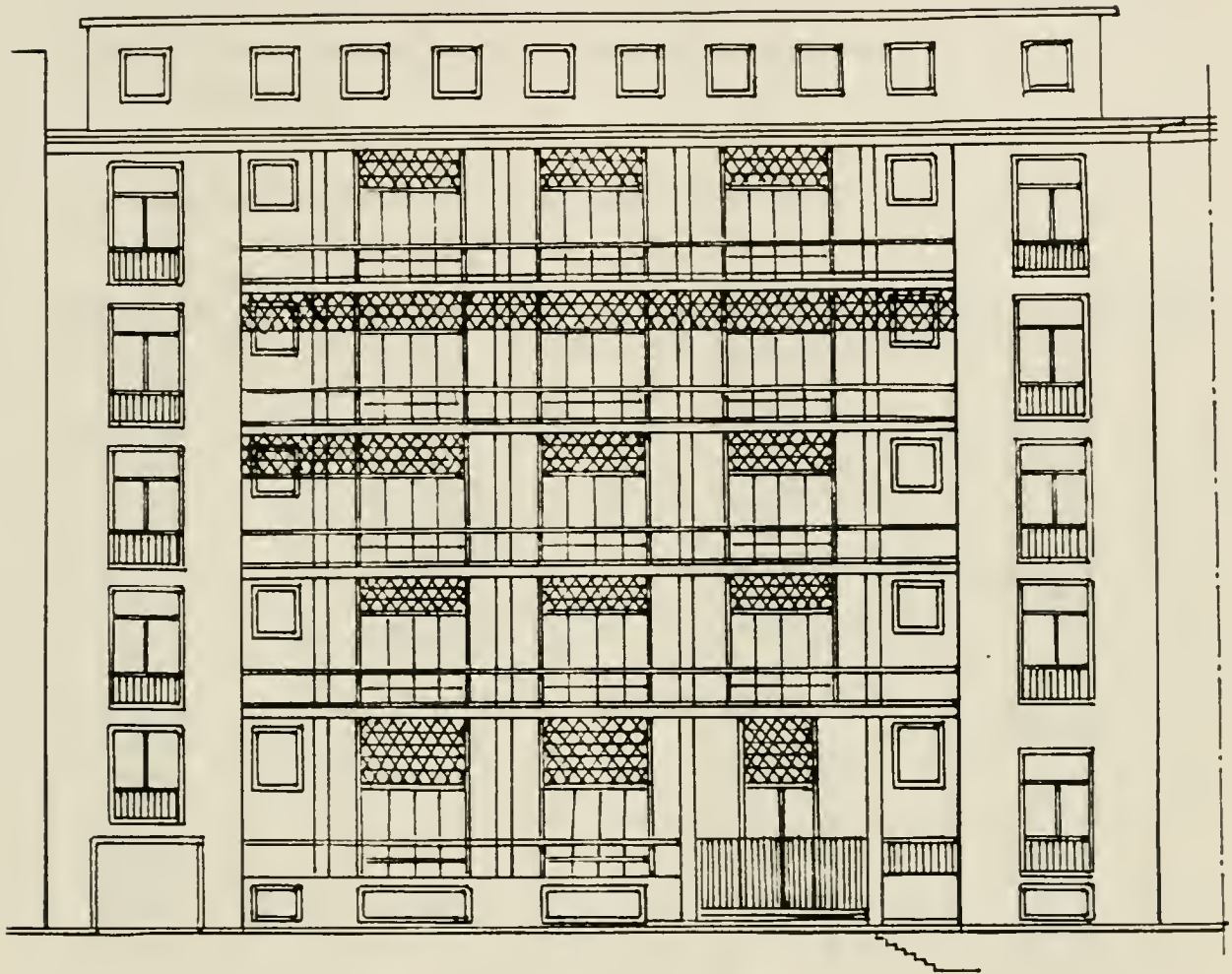


Figure (27): Immeuble Aghion. Reconstruction drawing of Perret's design. (by the author)

Champigneulle affirms that Perret designed this building by adding it in the architect's building list. He notes that its name was 'maison Aghun'. Apart from the misspelling of the owner's name, Champigneulle states that it was a 'maison' not an 'Immeuble'.<sup>62</sup> Two different dates are recorded as E. Aghion building's construction period: 1932 in Fanelli's book, and 1933 in Collins' review on Auguste Perret published in *Contemporary architects*.<sup>63</sup>

<sup>62</sup>Bernard Champigneulle, *Perret*, Paris, Arts et Métiers Graphiques, 1959, p. 150.

<sup>63</sup>Giovanni Fannelli & Roberto Gargiani, *Auguste Perret*, Editori Laterza, 1991, p. 192. Peter Collins, *Perret, Auguste*, in *Contemporary Architects*, p. 692. It should be noted that in Collins' review on Perret's biography, he misspelled the owner family name of the 1926's villa





Fanelli, in his Perret's building list presumes that Auguste Perret was involved twice in the design of that building; first in 1932, and second in 1933.<sup>64</sup> Fanelli shows only the 1932's project. There is no indication in Fanelli's review, as well as in Collin's and Champigneulle's, that the design had been executed.

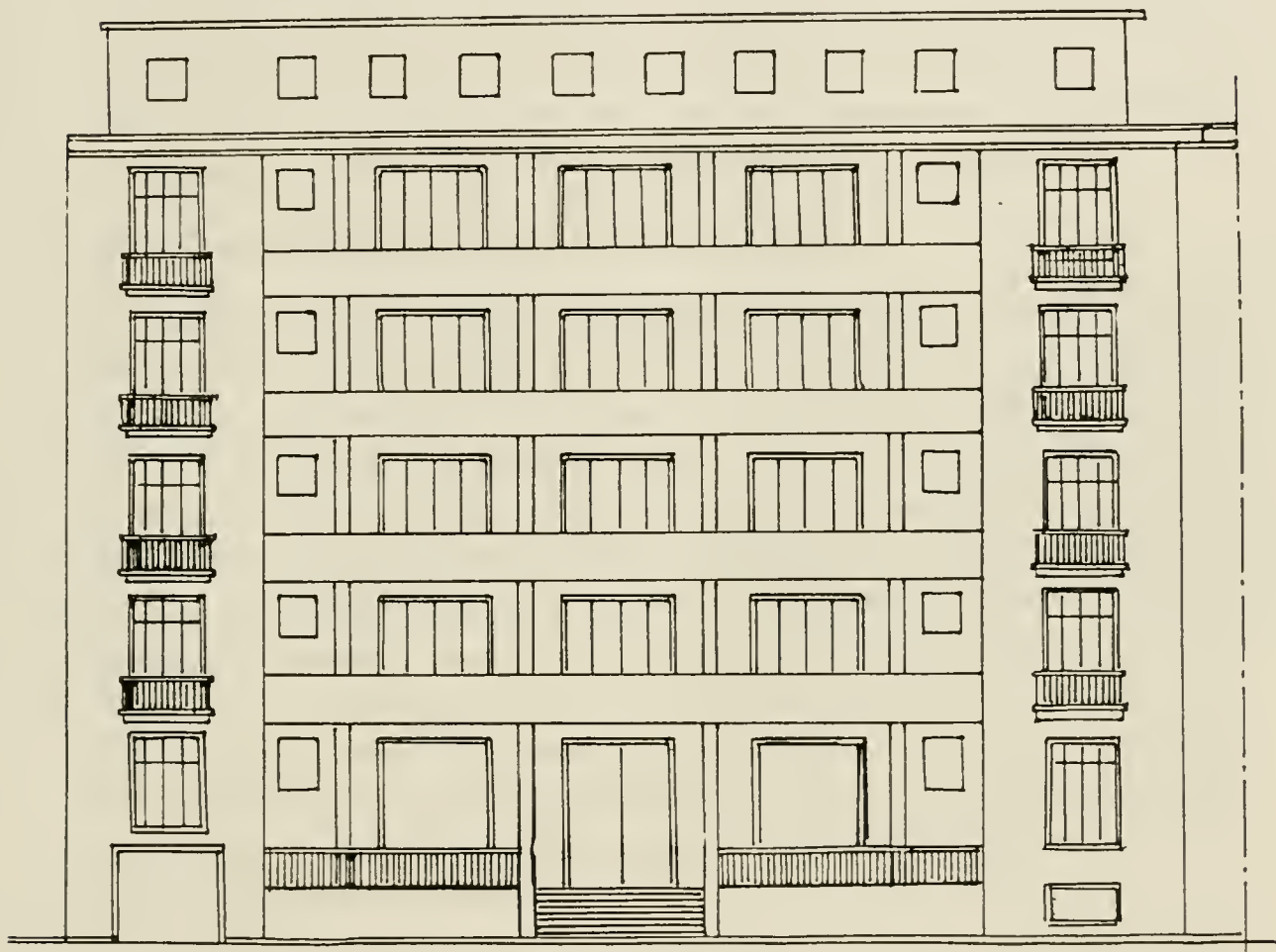


Figure (28): Immeuble Aghion. Reconstruction drawing the existing building. (by the author)

and the 1932's building (Aghia and Aghun respectively.) 'Aghion' is the right spelling of the owner family name.

<sup>64</sup>Two different addresses are provided to the two projects: rue Lomboso, rue Saurès for the first 1932 design; and rue Pasteur, rue Saurès for the 1933 design. What assures me that both projects belong to one site is that Fanelli provides Perret's drawing for the first project, and this drawing exactly coincides with the existing building in the second address (rue Pasteur, rue Saurès). See Perret's building list p. 192, in Fanelli, *Auguste Perret*, 1991.



Nevertheless, one who visits the address mentioned in Fanelli's building list (Rue Lombos, rue Saurès) can perceive that Perret's design had been executed, though some changes could be noticed comparing the existing building with Fanelli's published drawing of Perret's design. It should be considered that if Perret produced two projects for this building, as could be assumed from Fanelli's building list, it will be very interesting to compare both drawings and the actual building. It could also be assumed that Perret's second project, if it exists, could be closer in its details to the existent building. For that reason, and for comparison analysis as well, reconstructed drawings for both building's actual scheme and Perret's original design are to be provided.

### Edward Aghion's building: Architectural Description

The building is six floors height, including a stepped-back upper floor for the servants. It should be noted that the 1923 Alexandrine building regulations did not, as described before, limit from any viewpoint the building heights. The land property has three street facades: 32.00 m on Saurès street from the north side, 30.00 m. on Pasteur street from the east, and 24.00 m. on Baron Alfred street from the south. Another land property located at the corner of Pasteur and Baron Alfred street interrupts the regularity of property shape which, consequently, became an 'L' shape lot. The property of Gustave Aghion where villa Aghion exists, is situated towards the west of Edward's. Perret occupied only half of the width of the common line between Gustave and Edward properties with a blank wall that belongs to Edward's Immeuble. In doing so, he allowed morning sunlight to reach villa Gustave, and also respected the privacy of villa.

The building is situated at the north-eastern corner occupying the total length of the Saurès and Pasteur streets. It follows exactly the property line with its wide angle corner. Perret by situating the building in this corner guaranteed that the main residential spaces faced the north and the east. Northern and eastern orientations are the best orientations in Alexandria in terms of cold air circulation and sufficient sunlight.

The thickness of the building mass is approximately 15 meters. According to the 1935 detailed Maps of Alexandria, a separate small structure was built on the south side of the land, right on the property line of Baron Alfred street.





The land between the two structures is presently used as plant nursery. There is no indication of the original use of the latter structure, or its characteristics. However, the existing structure that coincides with the original outline at the same location, and is used for both parking space and storage area for the nursery equipment.

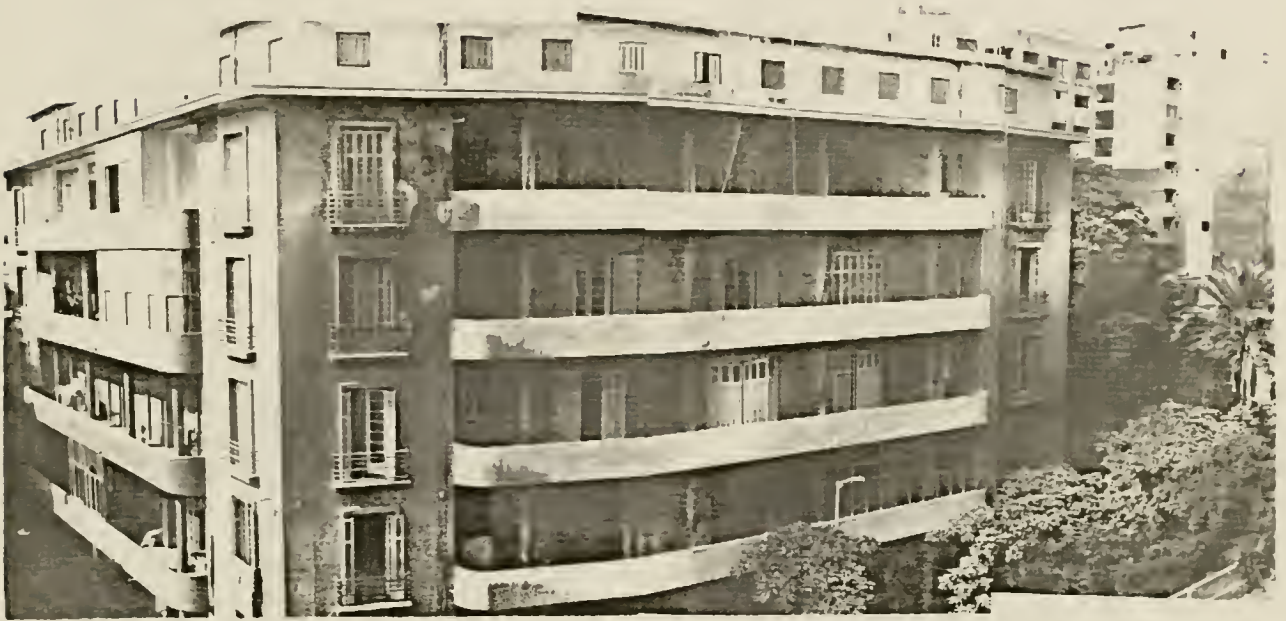


Figure (29): Immeuble Aghion, corner of Pasteur and Saurés streets, east and west elevations. Note Villa Aghion is situated at the far right of the photograph, right behind the palm tree.

Perret designed a symmetrical building taking the corner of Saurés and Pasteur street as his axis. Consequently, the two elevations are exactly the same design. In order for him to compensate the two meter difference in length between the two elevations (Saurés' is 32.00 m. and Pasteur's is 30.00m.), Perret refined the proportions on both facades. He chose Pasteur's east side to locate both the building entrance and the ramp that leads to the basement.

In Edward Aghion building, Perret designed a massive building that imposed itself on the site. Perret, before the 1930's, did not follow this approach in designing residential buildings. It seems that for him, only public buildings should express their mass. This is clear in his designs for the Alfred Cortot





Concert Hall, 1929 (entry 129), Théâtre de l'Exposition des Arts Decoratifs, 1924-25 (entry 77), and the Théâtre des Champs-Élysées, 1911-13 (entry 31). However, for him, the mass of an Immeuble de rapports should be dissolved in the streetscape by breaking its regularity which in this case he did not do.

The 'Immeuble de rapport Edward Aghion' is one of Perret's rare examples in which he coats the entire building with plaster eliminating the material articulation that differentiated the reinforced concrete structure and the infill. This recalls his approach in designing the Hôtel Particulier M. Mouron at Versailles, 1926 (entry 92). However, in the Alexandrine building, Perret shows his round reinforced concrete columns that support the balconies. He was also concerned with the reinforced concrete window frames which are slightly projected from the facade plane.

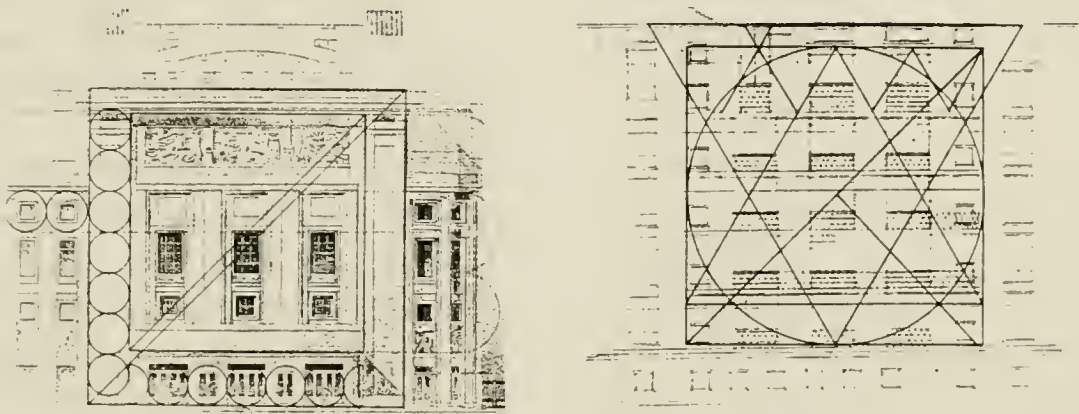


Figure (30): Geometrical proportions of Perret's public buildings: Théâtre des Champs-Élysées, 1911-13; and Aghion immeuble de rapport, 1932. (Fanelli, fig. 155-157). Note the upside-down position of immeuble Aghion's drawing, as published in Fanelli's.

It is very difficult to determine Perret's intention to coloring the building, since the latter was built, as it was mentioned before, far beyond Perret's design. However, Aghion's apartment building, as it stands in the present time, shows a pink-grayish plaster applied on the entire facade including the freestanding columns of the balconies. The rainwash over certain parts of the facade—the parapets and parts of the freestanding columns—revealed the original pink-grayish color. Otherwise the color of the facade were darkened due to the effect of air pollution. It should be mentioned that Perret experienced plastering his buildings in several projects: Hôtel Particulier Gaut, 1923-24 (entry 24), Hôtel Particulier Mouron, 1926 (entry 92), and the



south facade of Maison Awad Bey in Cairo, 1931-32 (entry 159). However, it could not be confirmed in the case of Aghion's building whether plastering the overall facade was the architect's intention.

Perret seems to level his architectural elements in various vertical planes not for the sake of showing their different functionality, but instead to achieve a certain monumental scheme. Perret might have had in mind specific geometrical proportions that he followed designing the façade. That was not a new approach for Perret. He actually undertook the same line earlier in several of his public buildings: Garage Ponthieu 1907-08 (entry 22); Théâtre des Champs-Élysées, 1911-13 (entry 31); and Alfred Cortot Concert hall, 1929 (entry 129). However, in the case of Aghion's building, Perret tried to diminish this imposed monumentality by integrating moderate details such as the sun-breakers and the metal handrails. Unfortunately, these elements were never executed, and what is left now is that large scale building that contrasts with the surrounding villas.

In this building, Perret provided different floor heights according to the use of each. First he unified all residential floors to 3.6 m. height, except the first entrance floor which is approximately 4.4 m. height. He was trying to give a prestigious quality to the entrance portal of the building. Perret, then lowered the height of the uppermost servants' floor to 3.2 m. He, finally provided only 2.7 m. height to the basement. It should be noted that the height of the basement is only calculated from Perret's drawing, published in Fanelli. The measurement was not checked because, at the time of the survey, the basement was flooded and closed.

Perret was trying through the facade to follow his idea of vertical French windows, that expand the total height of the floor (from slab finish to lintels' level). Only with some exception was this rhythm broken. That was in the bathroom openings and the servant windows of the uppermost floor of the building. In conjunction with the installation of these vertical French windows, Perret installed small projected balconies which enabled their shutters to open outwards. These balconies have no other function because of their narrow widths. It is not clear from the only Perret's drawing of the design, whether these balconies were included in the original design or not. It is also not clear whether Perret intended to provide shutters or not.



Reviewing Perret's residential buildings built before Edward Aghion's building, one can perceive that Perret used different kinds of shutters throughout his buildings. He even left glass windows without any shutters. (Compare the shutters in entries 12, 70, 92, 95, 100, 108, 127, 140, 141, 158, 161). That means that Perret, although adhering to the idea of vertical opening, did not limit himself with a special kind of shutters. Nevertheless, this wide varieties of shutters with which he experimented, make the estimation of the design of Aghion's original shutters difficult.



Figure (31): Immeuble Edward Aghion, north facade. Note the elimination of the opening frames from both the bathrooms' and the upper servant rooms' windows. Also note the massive balconies' parapets

It would be interesting to investigate Perret's arrangement of the spaces in the apartments. But due to lack of information regarding the interior plan arrangement this could not be achieved. However, one can estimate from the arrangement of the exterior openings that Perret reserved the street facade for both bedrooms, living rooms, and dining rooms. He then kept the kitchens and the services to the back facades. What confirms that the rear facades is





kept for the services is the existence of a service circular staircase that leads directly to the upper servants' floor.

What is immediately noticeable on the facade are the massive parallel balconies parapets. Perret's original intention was to provide simply designed metal parapets. It is doubtful that these massive parapets belong to Perret, especially because he never experimented with round edges at the intersection of parapets and building walls. I could not even deduce from Perret's drawing of the facade if he meant to project the balconies out of the property line.

Among the other details that were altered from Perret's design was the elimination of the opening frames from both the bathroom and the upper servant rooms' windows. Although this fact has no general effect on the scheme of the building, it affirms that this building was not erected under the supervision of its architect. For the reason that this building was executed far beyond Perret's design it could not be criticized in its details. Had the facade been executed according to Perret's original scheme it would elicit a totally different effect in the district of Wabour El Maya.

Contemporary to Aghion's Alexandrine building, Perret built Nubar Bey House, Garches, France, 1931 (entry 147 or 161); Elias Awad Bey House, Cairo, 1932 (entry 159). He also proposed several Algerians projects: Apartment building, 51-55 rue Raynouard, Paris, 1929-32 (entry 127); and Marine National Building, Paris, 1929-32 (entry 128).





#### 4.2.3. Immeuble de rapport Aly Yehia Bey, 1938-39

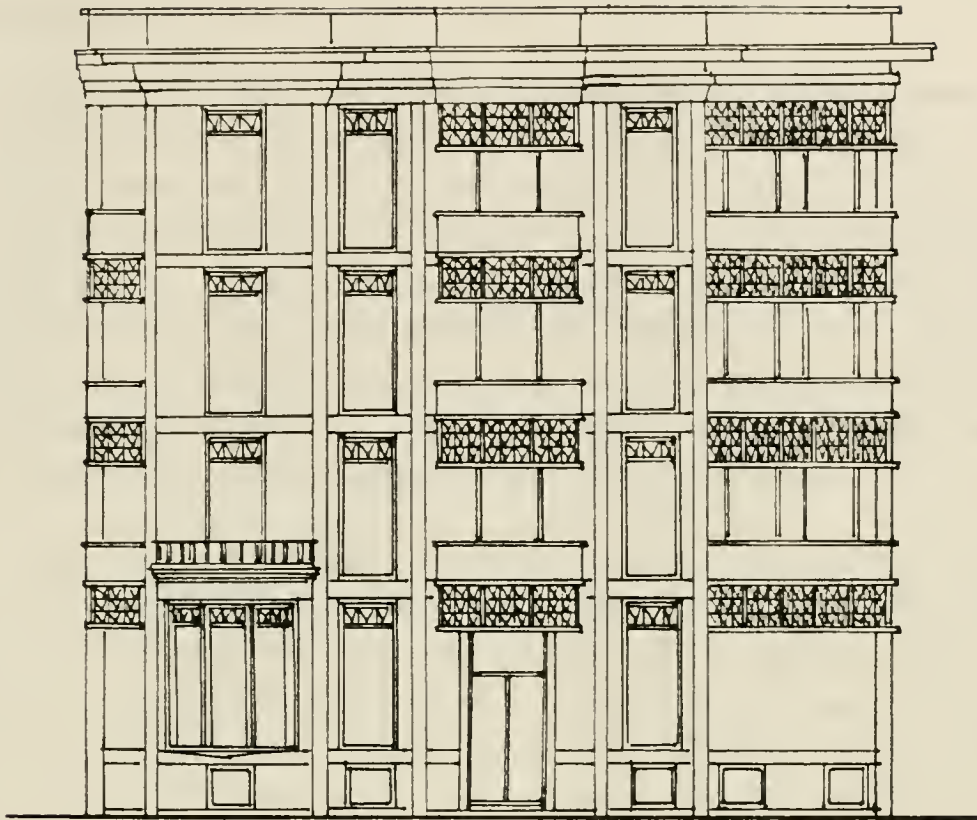


Figure (32): Aly Yehia building, south-eastern elevation, scale 1:200. The elevation is drawn upon the Fanelli's first floor plan and site visits. (by the author, 1993)

This building is not included in neither Jamot's (1927, too early to be included) nor Champigneulle's (1959) nor Collins' (1987) building lists of Auguste Perret. In fact, it is only Fanelli who includes the building in the architect building list. Fanelli also shows the first floor plan of the building.<sup>65</sup>

#### Aly Yehia's building: Architectural Description

The building is located in the same nineteenth-century Wabour El Maya district where both the Aghion villa and apartment building exist. It is situated two blocks south of the other two Perret's buildings, on the corner of Kukh and Belahrs streets. The site has 26.5 m. length on Belhars and 33.00 m.

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<sup>65</sup>Fanelli & Gargiani. *Auguste Perret*, Editori Laterza, 1991. See p. 192 for Perret's building list, and fig. 227 for the first floor plan of Immeuble de rapport Aly Yehia, 1938-39.



on Kukh. Unlike the two previous properties, Aly Yehia's is almost shifted 45° degree on the main directions. The land faces, then, north-east north-west south-east and south-west directions.

The building is set back from Kukh street side (approximately 6 meters), and is set just on the property line from Belhars street side. In this case, Perret did not let the cantilevered balconies from Belhars side to project over the street. However, he was careful that the boundaries of these balconies terminated on the property line. This approach, which was not followed by Perret in the case of Edward Aghion's apartment building, demonstrates his understanding of the narrowness of Belhars street (10 m.). It also confirms his concern with the overall quality of the urban environment of the district by providing enough public space that permits enough air-circulation, and sunlight.

The average floor to floor height is approximately 4 m. It is not clear whether or not Perret provided an upper floor for the servants. An additional two stories were added to the top of the building in an unknown time. This addition eliminated any evidences of servant floors. A basement floor is included in the design, whose entrance is on from Belhars street (north-east side). Perret in Yehia's building, unlike Aghion's, elevated the first floor for about 2.70 m. from the ground level. By doing so, he did not have to lower the level of the garage level. This approach of design to elevate the residential spaces to the first floor rather than the ground floor was first practiced by Perret in 51-55 rue Raynouard, Paris 1930-1932 (entry 127).<sup>66</sup> Moreover, it seems that from his previous experience, with lowering the garage under the ground level of Aghion building, Perret understood that it could cause some problems with water drainage.<sup>67</sup>

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<sup>66</sup>Perret also elevated the residential spaces to the first floor in his Immeuble de rapport, 48, rue Raynouard, 1906. In this case, though, he did so to provide shopping areas towards the street facade. His first practice to provide parking area in the ground floor was in 51-55 rue Raynouard, then followed, though lowered underground, by Aghion's building, 1932. He finally followed the same idea of the ground floor garage underneath the building in Aly Yehia's building, 1938. Perret, as far as I know never applied this idea latter in his residential buildings.

<sup>67</sup>In the present time, the garage level of Aghion's building is closed because it has been always a source of underground rising water, or collecting rainwater from the not well drained street around the edifice. It seems that the drainage system of that level was not carefully designed. Lack of maintenance is also assumed.





Figure (33): Aly Yehia building North corner, Intersection of Kukh and Belhars street. Note the additional top two floors.

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Perret designed a set of very effective sunbreakers that he installed on all four facades. By doing so, he did not specify if these sunbreakers were meant for a climate control or for ornamental purposes. However, I think, that they play both roles. They not only provide enough shades into the balconies, but also unify the broken mass of the building. Perret, though, exaggerated the scale of these sunbreakers. He divided the height of the floor into three distinctive planes: the solid parapets (1.20 m.), the sunbreakers (1.20 m.) and the void of the balconies (1.80 m.)

Although never executed in the case of Aghion's apartment building Perret suggested in the earlier Alexandrine buildings metal handrails for the balconies. In Yehia's building, one could assume that Perret originally designed metal handrails following his previous design ideas. In fact, it is not clear since there is no published elevation that can corroborate this assumption. However, I think in this case Perret actually designed solid





parapets that suited his extensive articulation with the concrete blocks. In Yehia's building facade, I think, Perret in addition to his usual expression of structural elements was playing with both solid and void, light and shades. In addition, the material articulation exhibited on the mass of the parapet itself confirms that it was Perret's original design.



Figure (34): Aly Yehia building, north western corner, Belhars street. Note the material articulation on the mass of the parapets, also the clear distinction between solids and voids.

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The only exception where the architect used a metal handrail was in the second-floor round terrace, south-eastern elevation. It seems that in this particular case Perret realized that if he used a solid parapet he would exert more weight on the projected window-bay mass.





Figure (35): Aly Yehia building, south eastern facade, projection of first floor bay window.

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Figure (36): Aly Yehia building, south eastern facade, first floor bay window projection. Note the round balcony metal handrail, and Perret's articulation of different structural elements.

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One of the most interesting studies that could be conducted is the analysis of the interior spaces of the apartments since Fanelli provides us with the first floor plan of the building. Although the published plan is not quite readable, one can deduce from its space arrangement that Perret divided each floor into two apartments. The first floor plan in the case of Yehia's building is not considered the typical residential floor because Perret projected his balconies from the second floor, and because of the surface area reserved to the entrance of the building. Perret in order to compensate the apartment on the first floor, provided this round projection bay as a master bedroom. The first floor plan shows that Perret actually designed two bedroom apartments on each floor. Each contains an entrance lobby, a dining and living space. One should note the separateness of the sleeping areas from the living spaces from the services.

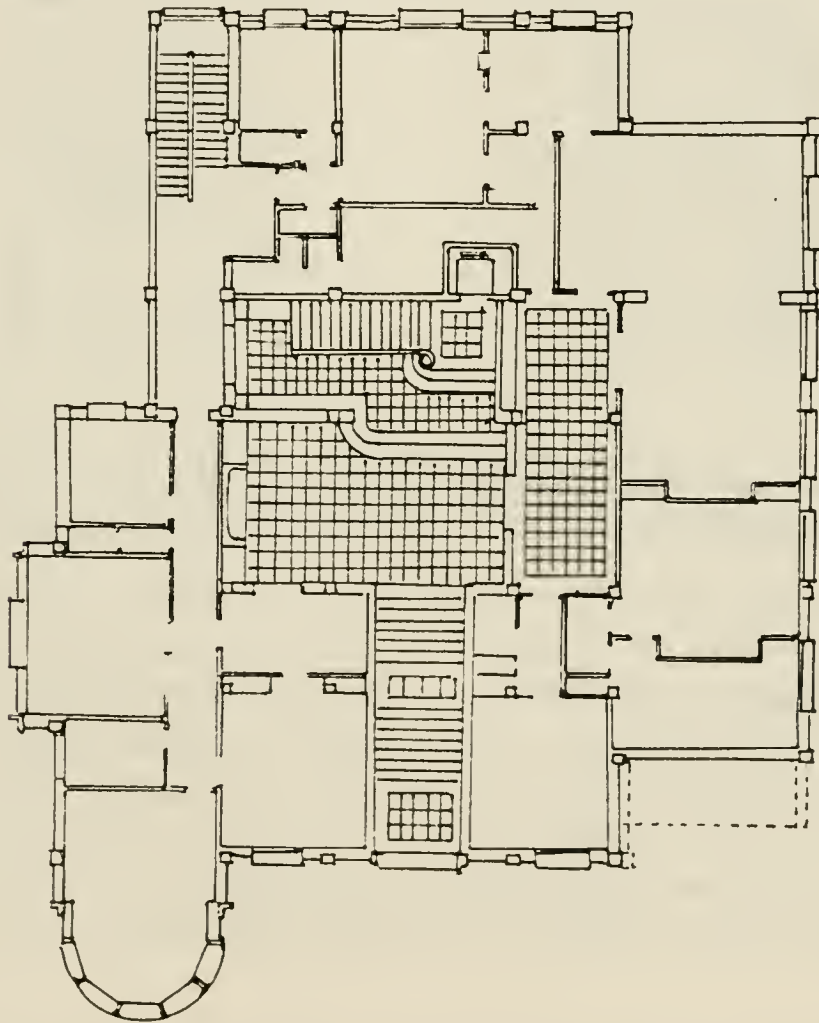


Figure (37): Aly Yehia apartment building, first floor plan, redrawn from Fanelli's published drawing, scale 1:200. (extracted from Fanelli fig. 227, drawn by the author)





Two staircases are provided in the building: the main staircases in the central core of the building, associated with an elevator, and a service staircase located at the north western corner of the building. The former is connected to the two apartments by service doors near the kitchen area. Perret defines the spaces in his drawing by suggesting a system of furniture for each room. It is not certain that the same division is followed in the upper floors. However, I believe from interviewing some of the present residents, that each floor consisted of two apartments, and that the one located on the corner of the Belhars and Kukh was given the privileges in terms of surface area.

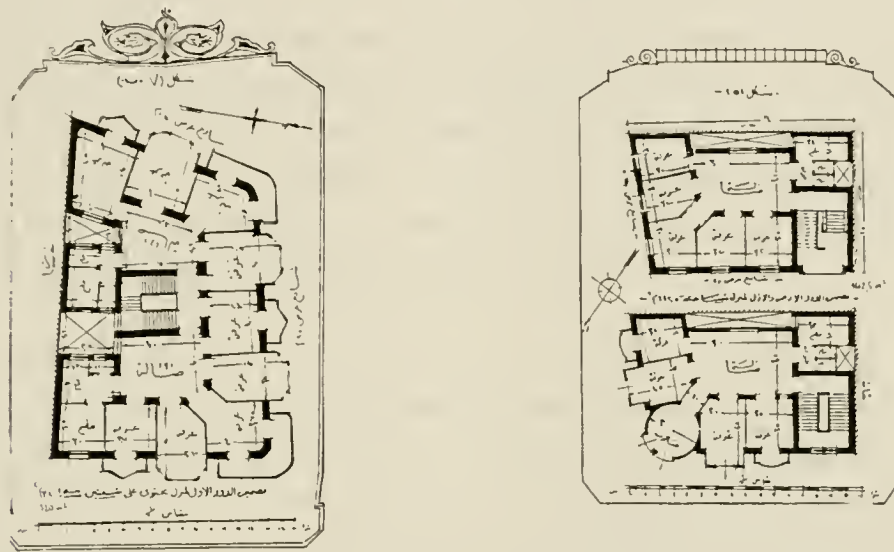


Figure (38): Example of two prototype apartment buildings. Note that the rooms are labeled (Ghorfa) meaning room, and all the rooms are gathered around a central space. Extracted from Abd al-Mun'im Arif (Handassa al-'imara), 1932. (from Volait, *demeures du Caire*, p. 93)

By specifying and separating the uses of the rooms, Perret departed from typical residential plans that were standardized and collected in some building catalogs distributed in Egypt after the 1930's. These catalogs aimed to present models of residential buildings, and were not concerned with the social values of Egyptian lifestyle. Rooms in these plans are labeled as *Ghorfa*, which simply means room, and they are all gathered around a central hall called *Sala*. There was no distinction between living, sleeping or private, semi-private, and public usage in these rooms. Examples of these catalogs are:





Nagib Gubran (*Wasif fi fan al-'imara*), 1929, Abd al-Mun'im Arif (*Handassa al-'imara*), 1932.<sup>68</sup>

Perret demonstrates in Yehia's building one of his finest articulations in differentiating between construction elements. He identified three different vertical planes to differentiate between uncovered reinforced concrete elements. The planes are arranged respectively from outside to the inside as following: the window frames, the beams, and the columns. In Yehia's building, unlike the case of Aghion's villa, Perret respected this order. It is only in the entrance bay of the south eastern facade that he broke the arrangement, and let the columns project over the beams. It seems that he was concerned with providing a prestigious verticality to the entrance bay. Apart from this exception, Perret's articulation in detailing these different vertical levels was very accurate. Evidence of this precision are the fitness of the concrete blocks in their panels, the corner articulation of the load bearing elements, and the fine profile of the upper cornice.

Perret used two kinds of infill material throughout the building. He used sandstone blocks as a main infill material, and plastered bricks in the case of the parapets. For the infills, Perret chose colors homogeneous with the uncovered concrete. He used pinkish-gray sandstone and gray plaster. In doing so, Perret provided an overall gray color to the building. This approach of unification differs from his idea to frame beautiful brickwork with the concrete elements in villa Aghion. In Aly Yehia building, Perret seems more confident with reinforced concrete. By articulating the concrete constructional elements, Perret finally seems convinced with the beauty of the material. Nevertheless, Perret, similarly to his design approach in Aghion's villa, introduced two new color schemes to the Wabour El Maya district: the first is the gray reinforced concrete already experienced in Villa Aghion; the second is this odd pinkish sandstone color that opposed with the whitish-creamy that was the general scheme of Alexandrine plaster finish in early twentieth century. Throughout his building list, Perret's use of stone-

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<sup>68</sup>See, Volait, *L'Architecture Moderne en Egypte et le Revue El Emara* 1939-59, CEDEJ. Cairo 1989p.101-102, and *Grandes demeures du Caire au siècle passé, Les Cahiers de la recherche architecturale: espace centré, figures de l'architecture domestiques dans l'Orient méditerranéen*, No. 20-21, 1987, pp. 92-93.



blocks as an infill material was rare. Maison Arakel, 1931 (entry 147), Maison Awad Bey, Cairo, 1931-32 (entry 159) and Usine Issoire, 1939 (entry 214) were among these few examples.

Contemporary to Aly Yehia's Alexandrine building, Perret built the famous Museum of Public Works, Paris, 1937 (entry 197). Perret probably liked the design of the concrete blocks used in Yehia's building and he applied them as decoration elements on the facade of the Parisian Museum. Being hidden underneath the projected cornice, these blocks do not have the same climatic role as it has in the case of Yehia's building. Perret parallel projects in France shows a great inspiration from his Alexandrine building.

#### 4.2.4. Perret's Interpretation of the building regulation

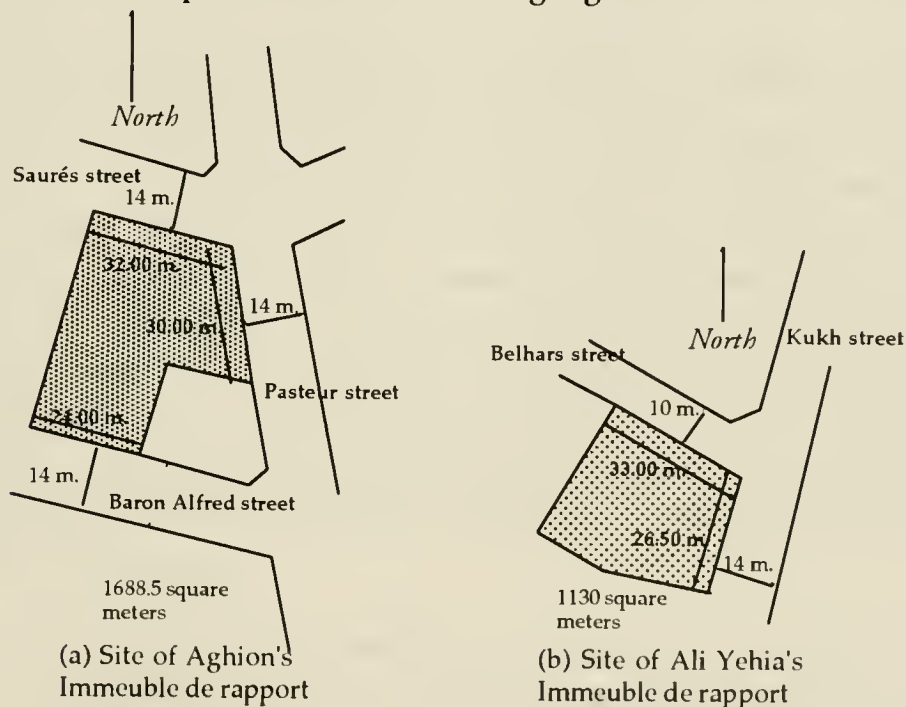


Figure (39): Aghion's and Yehia's building site. (by the author)

Edward Aghion Immeuble de rapport was erected just on north and east property edges. Perret did not provide a front yard on the side of the streets. In that respect, it seems that he failed to comply with the New Lay-Out planning regulations that were initiated in Alexandria, May, 1923. These regulation stated that "in all new lay-outs for building purposes the proprietors must reserve for streets which will become public an area equal to one-third of the total area of the land to be laid out. In the case of existing



streets bordering the land to be laid out, half the width of these streets shall be included in the calculation of the required area of one-third of the total.”<sup>69</sup>

However, a careful examinations and calculations applying the regulations on this particular site, reveals that Perret was aware with the law. Since the width of both main existing streets on which the property is located (Saurés and Pasteur street) is 14 meters, and the property has a total length of 62 meters on these streets,  $[(14 \times 62)/2]$  434 m<sup>2</sup> could then be added to the calculation of required area public needed according to 1923's regulation. One third of the total area of the land (1688.5 m<sup>2</sup>) is 562.83 m<sup>2</sup>. This means that for this particular land, an area of (562.83 – 434) 128.83 m<sup>2</sup> (or a depth of 2.08 m along the land street edge) should be left from the streets side for public use.

However the property has a third street facade (24 m length) on Rue Baron Alfred (14 m wide) in the south side. This will allow an additional (24 x 7) 168 m<sup>2</sup> that could be added to the calculation of the required public area. From a comparison between the set back area calculated previously and the later additional area-credit, one could conclude that there is still potential to erect a building just on its property-line. It seems that Perret was fully aware of the Egyptian law by building his immeuble just on the property line. His architectural solution was, as usual, clever, because it not only respected the building regulations but also profited from these law by providing a new architectural approach that suited the limitations. Perret's apartment-buildings in France, for example 25 bis rue Franklin (entry 12), Paris, 1902-03, emphasize this manner.

In the case of Ali Yehia's Immeuble de rapport the total area of the land property is approximately 1130 m<sup>2</sup>. Of this area, according to 1923 regulations, the third (376.6 m<sup>2</sup>) must reserved for streets. The width of both existing Kukh and Belhars streets are respectively 14 and 10 m. The property has approximately 26.5 meters length on Kukh and 33 meters on Belhars.

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<sup>69</sup>Riad, Mahmoud. *Alexandria; Its Town Planning Development*, in *The Town Planning Review*, Vol. XV, No. 4, December, 1933, pp. 246. What is relevant about the interpretation of that regulation is that one third of the property area should be left along the property border, in which half the width of the street is included.





Consequently, according to 1923 regulations,  $[(26.5 \times 14 + 10 \times 33) / 2]$  350 m<sup>2</sup> could then be added to the calculation of required public area.

Comparing the two resultant areas , an area of (376.6 – 350) 26.6 m<sup>2</sup> (or a depth of 0.45 m along the land street edge, or 1 m. along Kukh street) should be left from the streets side for public use for this particular land. Perret respected the regulation and provided enough set-back area on Kukh street (more than one meter), and he actually built on the street line on Belhars street.

Although it seems that Perret wanted to take advantage of the building regulations by profiting from their limitations in the case of Aghion's building, he respected the urban values of the streetscape in Yehia's building. Whereas he stopped all his projected balconies before the property line on Belhars street, respecting the fact that this street is narrow (10 m.), and allowing more air circulation and sunlight to the neighbors.



## 5. Conclusion

### 5.1. Haramlek; a social respect

Vogt-Goknil emphasizes the conservative social aspect of the separation between the men's and women's quarters in the traditional house saying "... separate entrances and quarters for men and women were provided to all houses and without social distinction. Even houses consisting of only two rooms were divided into 'harem' (women's quarter) and a 'selamlik' (men's quarter)."<sup>70</sup>

Perret's structures in Egypt confirm the architect's respect of the traditions. He introduced a new architectural space typology to his villa Aghion; the *salamlek*, that he never used in France before. It seems that he was aware of the difference between the *haramlek* and the *salamlek* spaces in the house.<sup>71</sup> For him, thus, architecture is not a reform of the world, it is a response to social, economic, traditional and climatic factors. His intention, by introducing new material to the residential units, was not to invent a new residential typology, and consequently originate a new life for Egyptians. Instead he adhered to the existing Egyptian social values. For him it was only the one who will live in the villa who can dictate its program. He believed that art can only exist in the environment in which it is developing. This confirms with Perret's answer when he was asked about 'tomorrow's theater'. He said:

Vous me demandez ce que sera demain le théâtre? Comment le saurais-je? Ce n'est pas l'édifice qui fait le spectacle. C'est plutôt le contraire. L'édifice théâtre obéit à un programme dicté par l'auteur, le metteur en scène, le directeur: il est l'expression de ce théâtre.<sup>72</sup>

Consequently, in the case of the three Alexandrine buildings, I disagree with Joseph Abram who states that "jamais ces architectes (the Perret brothers: Perret and Gustave) n'auront vraiment cherché à renouveler l'espace interne

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<sup>70</sup>Vogt-Goknil, *Ottoman Architecture*, Old bourne, 1966, p. 140.

<sup>71</sup>It should be noted that J. Guadet in his habitation typology mentioned the Muslim *harem* and its function in the house. See Guadet, *Eléments et Théorie de l'Architecture*, volume II, p. 21.

<sup>72</sup>A. Perret, *Le Théâtre de demain. L'opinion de M. Auguste Perret*, *L'Architecture d'aujourd'hui*, June-July, 1931.



de la maison, de l'appartement."<sup>73</sup> Although Abram does not ignore the creativity that Perret expressed in his concrete, he accuses that his preoccupation with the search for new technology resulted in little contribution to internal residential space arrangement. Perret's designs in Egypt give a new classical impression. The word classical, here, has to do with the relationship between the material used and the program. 'Classical' for Auguste, in this case and probably in others, meant to translate the traditional, social, political, climatic conditions into a particular design of a reinforced concrete building—the only material, as far as he was concerned, which belonged to twentieth century. This approach was not only limited to Egypt; Perret also gave careful consideration to the traditions of other countries where he built. One could not ignore his concerns with the Moroccan vernacular architecture in building Docks of Casablanca 1915-16 (entry 38). He seems to follow the words of his professor, Guadet, when he was asked about his opinion on what is original. Guadet said:

C'est de faire très bien ce que d'autres ont fait simplement bien. Les plus belles époques d'art sont celles où la tradition était la plus respectée, où les progrès étaient le perfectionnement continu, l'évolution et non la révolution. Il n'y a pas, il n'y a jamais eu de génération spontanée en art. . . <sup>74</sup>

Perret followed two different design approaches in his Alexandrine structures. The first was to follow the concept of Palladian villa by locating the building, whether it is a villa as in Aghion Hôtel Particulier or a apartments building as in Aly Yehia Bey Immeuble de rapport, within the property lines, and therefore creating four facades, and a central hall. The second is constructing exactly on the property lines, as Perret did in the case of Edward Aghion's Immeuble de rapport, limiting himself to only two street facades. One has to note that in these three cases, Perret had enough land to place his structures inside their property lines. It is noticeable that his incredible respect of his older Aghion's Hôtel Particulier, forced him to design a blank facade facing it, in an effort not to compete with it. This approach led

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<sup>73</sup>Joseph Abram, *Un savoir urbain implicite: les immeubles de rapport des frères Perret*, *Les Cahiers de la recherche architecturale: L'Immeuble*, No. 22, 1988, p. 54.

<sup>74</sup>Guadet, *Eléments et Théorie de l'Architecture*, cours professé à l'Ecole Nationale et Spéciale des Beaux-Arts, Paris: Librairie de la Construction Moderne, vol. I, p.134.





to an awkward solution towards the urban fabric of the neighborhood that was characterized by its spacious detached villas in comparison with the dense pattern of the Arab towns.

## 5.2. Design for hot/humid climate; Sun breakers (*brise-soleil*)



Figure (40): Le Corbusier, "En bâtissant moderne, on a trouvé l'accord avec le paysage, le climat, et la tradition". (Le Corbusier, *Œuvre complète 1938-1946*, vol. 4, p. 123)

In his Egyptian designs, Perret recognized the Egyptian sunny and hot summers, and cold winters. He was also convinced with the use of long traditional French openings. Therefore he was looking for some device to combine both concerns, enabling the sun to have its full effect in winter and preventing it in the hot days of summer. Le-Corbusier, later, expresses this problem by saying that "le plan de verre est une conquête inestimable. . . car le soleil, ami de l'homme, devient ennemi emplaceable aux heures de pointe en été, et très particulièrement sous certaines latitudes. Il s'agit donc de trouver un dispositif qui permette au soleil de donner son plein effet en hiver et d'être jugulé en été, aux périodes caniculaires."<sup>75</sup> Following Perret's respect of tradition, Le Corbusier was concerned with the harmony between climate and tradition in building in a modern way.

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<sup>75</sup>Le-Corbusier, *Problèmes de l'ensoleillement; Le brise-soleil*, *Le Corbusier: Œuvre complète 1938-1946* (7th edition, W. Boesiger, publisher) vol. 4, Les Editions d'Architecture Zurich, 1977, p. 108. It should be noted that Le-Corbusier was one of Perret's early students. In fact, Le-Corbusier was employed by Perret as a student for eighteen months. For the opposition between the pioneers' theories, see Giovanni Fanelli and Roberto Gargiani, *Perret e Le Corbusier: confronti*, 1st ed, Roma: Laterza, 1990.



In his first attempt in Alexandria, Gustave Aghion's villa, 1926, Auguste Perret, attached to his French background, provides a Palladian villa that has nothing to do with the Alexandrine hot and humid weather. He also used his French-windows without any kind of sun protection, except the wooden shutters. However, although limited, his introduction of pre-cast blocks as a means of sun-breaker to protect the large glass portal of the south porch gives this building different qualities than the ones he built in France.

Then, Auguste realized that in order to build in a hot and humid climate, architects should provide large balconies that act as a cooler station in the air circulation circle. He also realized the need of sun-breakers, especially in the case of the external balconies, to emphasize this cooling system. Therefore, he designed a longitudinal set of these precast units that protected the northern and eastern balconies of Edward Aghion's apartment building. Unfortunately, these sun-breakers were not executed. Consequently, the owners of the apartments started to enclose parts of these unused balconies, especially in the eastern façade where the sun has greater effect.

Finally, in his design for Aly Yehia apartment building, Auguste designed, and luckily executed, a very effective set of sun-breakers that surrounds the four façades of the building. Although exaggerated in scale, these sun-breakers not only protect Perret's large openings from direct sunlight, but it provide a pleasant aesthetic value of the building, especially because they act as an aesthetic link between different façades of the building. Moreover, they provide a cooling station in the air-circulation system. It seems that the owners of the apartments in this case appreciate what Perret designed for them, moreover, they installed, specially in south eastern façade wooden units of sun-breakers that have the same design, though in a smaller scale, as Perret's.

It is interesting to note that Perret did not provide sun-breakers in any of his residential buildings except those designed in Egypt. Although in the case of Edward Aghion's Immeuble de rapport sunbreakers were not executed, Perret included them in his original design. His understanding of the weather conditions of such a hot country generated this adaptation. Not only did he respect the weather conditions in terms of temperature, but his understanding of the humidity in Alexandria drove him to design shaded



exterior balconies that helped to circulate cool air. These balconies are not provided in the design of the Cairote Awad Bey villa, where the weather is only hot and dry.



Figure (41): Aly Yehia building, south eastern facade, entrance gate. Note the design of the wooden screens in the second floor balcony.

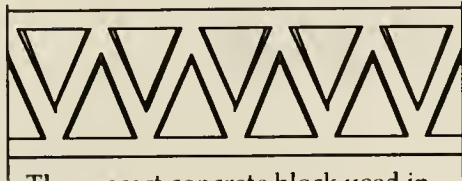
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One should note that the blocks that Perret used here are different than the one used in Aghion's villa and those of Awad Bey villa in Cairo, 1931 (entry 159). In the case of Aghion's villa the blocks were cast so that each unit contains a set of equal pyramidal shapes, without any vertical elements. They were long blocks, and their length was determined by the distance between the elements that they were installed between. The number of the pyramidal shapes were determined by the total length of the unit. Perret also provided a curvature to the unit so it could adapt to the curvature of the eastern porch. In Awad Bey villa, Perret's drawings reveal that the units were pure pyramidal shape, and that they were used both upright and upside-down. In order for these units to fit within their panels, a half block was required (see





entry 159). Latter, in Yehia's building Perret used precast square units that are joined together with metal ties within a cast in place reinforced concrete frames. Perret used the same blocks a year earlier in the Musée de Travaux Publics, 1937 (entry 197). No fraction of the blocks were needed to fill the rectangular panels. However, precision in pouring the concrete panels is required in this case.



a-The precast concrete block used in Gustave Aghion villa, 1926. Note that a curvature is provided along the length of the block to suit the curvature of the eastern porch of the villa, where these blocks are installed.



b- The precast concrete blocks used in Awad Bey villa, Cairo, 1931. (see entry 159)



c-The precast concrete block used in both Musée de Travaux Publics, 1937 (see entry 197) and Aly Yehia apartment building, 1938.

Figure (42): Evolution of Perret's concrete blocks design. Note that the drawings are not scaled, they are only proportioned from photographs, or Perret's design-drawings. (by the author)

From Perret's evolution in using pre-cast concrete blocks, one can conclude that early in Perret's career, the concrete blocks did not dictate anything in the overall design of the building. They were considered longitudinal elements that could be sliced to fit in a certain position. However, later in the 30's, Perret seems very concerned with these blocks. He provided a certain shape for each , and by putting them aside, he could fill the required panels. The dimensions of these blocks dictate the dimensions of the panels, and consequently the hole design.



### 5.3. Perret sings the oriental

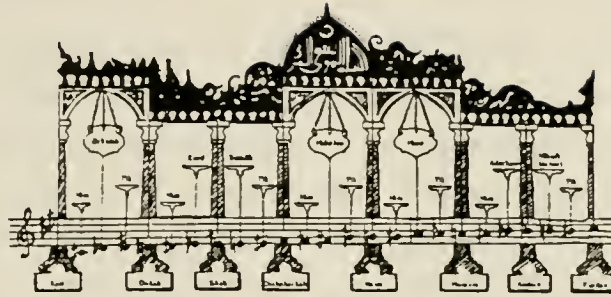


Figure (43): Tones in the Arabic music, by Habib Hassan Touma, La Musique Arabe, Paris, 1977. (Volait, p. 106)

Although Perret's buildings in Egypt were, as I see them, pioneer works in the evolution of Egyptian architecture, they were not appreciated by local architects. Sayyid Karim saw this architecture in general as an importation or imitation from the West. He also states, considering architecture as frozen music, that in order for an architect to build in the Arabia he must be familiar with the constant repetition of the intermediate notes in the Arabic music. For Karim, it is this repetition that produced the regular rhythm of arches and openings.<sup>76</sup>

However, later in his article, Karim states that in order for the modern Egyptian architects to express the diversity of nationalities that existed in Egypt in early 20th century, they must mix "the Turkish *taqassim*, the Italian *Opera*, the Spanish *tango*, the Austrian *valse* with the *mawwal baladi* in one spectacle."<sup>77</sup> This admixture is what Perret was trying to achieve. By trying to produce a 'singing façade', Perret combines several odd musical notes, and tries to harmonize them.

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<sup>76</sup>Sayyid Karim, *Towards a National Architecture in Egypt*, al-'imara, No 5/6, 1940, pp. 271-275.

<sup>77</sup>The *mawwal baladi* is a type of Egyptian music that flourished in the countryside. It is mainly based on stories that have a certain moral advises.



#### 5.4. Antiquities' law and Perret's Alexandrine buildings

It seems that not only local architects who dislike Perret's modern contribution in Egypt, but also the local authorities. These buildings are not yet registered as National monuments. According to the 1983's Egyptian law for the protection of historic monuments, the object should be at least 100 years old to be selected.<sup>78</sup> Nevertheless, if a structure representing the ideal use of reinforced concrete in Egypt needs to be chosen, both Gustave Aghion villa (1926) and Immeuble Aly Yehia Bey (1938-1939) qualify as serious candidates.<sup>79</sup> I excluded Aghion's Immeuble de rapport because this building had been executed far beyond Perret's design. The research then mainly affirms the importance of Perret's buildings in Alexandria from different viewpoints such as:

- a) The buildings represent the first attempt to use uncovered reinforced concrete in Egyptian residential buildings.
- b) They are designed by August Perret one of the pioneers architects of the world modern architecture, whose work has significantly influenced the architectural development of the twentieth century.
- c) The buildings not only are considered entities in the history of constructional development in Egypt, but also important examples of the worldwide twentieth century development of reinforced concrete.
- d) The buildings embody distinguish characteristics of architectural style and engineering specimen.
- e) The general good condition of the buildings should be investigated to set up standards for the use of reinforced concrete in Egypt.

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<sup>78</sup>Law No 117, 1983 for the protection of historic monuments states that a historic monument is every building or object that "is production of various civilizations, or originated by a historical art, science, literature, or religion of the consecutive historic eras; is dated at least a hundred years from its origin time; embodies a monumental and historical importance that shows the aspects of different civilizations which had grown on the Egyptian land or was connected historically with Egypt. This also includes the human carcass and the contemporary creatures. (text originally in Arabic, translated into English by the author)

<sup>79</sup>My choice of these two buildings among Perret's three Alexandrine buildings, is that because the execution of the third building, Immeuble Edward Aghion (1932-33), was far removed from the architect's design.





## **5.5. Reinforced Concrete: Analytical Survey**

The previous points are sufficient to consider registering Perret's buildings, especially the villa and Yehia's building, as national monuments. Consequently, a plan for an analytical study to survey the conditions of the reinforced concrete will be suggested in this section. Since, the buildings are generally in good condition, this plan will be important to extract values from Perret's construction methods and his use of reinforced concrete. This will lead, I assume, to upgrade the reinforced concrete construction techniques that is almost considered the only building technique practiced in Egypt nowadays.

### **5.5.1. Importance of the analysis**

The Importance of the analyzing the reinforced concrete of Perret's buildings in Alexandria could be summarized in the following points:

- a) Investigate the original building techniques practiced at the time of the construction, trying to infer traditional values that resulted good quality of reinforced concrete.
- b) Estimate the location from which the building materials came from in order to facilitate the repair work.
- c) Understand the original aesthetic intention of the architect towards the exposed material; texture, color, . . . etc.
- d) Understand the mechanical, chemical, physical properties of the concrete, and how these properties fit into the structural system in which the architect used the material.
- e) Understand the material deterioration procedure due to weathering, biological growth, structural failure . . . etc.
- f) Investigate the history of building repair and, if it exists, how did it affect they the structures.
- g) Design a maintenance plan and estimate its time intervals. Improper Maintenance of historic buildings can cause long-term deterioration of concrete.



### 5.5.2. Analytical methodology

William Coney defines an analysis and testing planning for concrete building pointing out to four major step: "document review, field survey, testing, and analysis. The basic step of his approach is document review."<sup>80</sup> Although plans and specifications for the three Perret's structures are not much existent, they can be an invaluable aid for future repairs. They may provide information on the intended composition of the concrete mix, or on type and location of reinforcement bars within the concrete core. Old photographs, records of previous repair, or building construction documents may also be evidences of original state and changes over time.

Field survey shall include a thorough visual examination which can assist in locating and recording the type, extent, and severity of stress, deterioration, and damage of the concrete and its surrounding materials. It is recommended that this survey will be based on certain standards to determine precisely damage degrees. The American Concrete Institute published a useful guide standardizing degrees of deterioration severity for making a condition survey for concrete. The guide includes a check list of the many details to be considered in making a report, and provides standard definitions of 40 terms associated with the durability of the material. It should be noted that all the deterioration procedures are illustrated to facilitate the understanding of the guide's definitions.<sup>81</sup>

Two types of testing, on-site and laboratory can supplement the field condition survey. On-site, non-destructive testing may include the use of Schmidt rebound hammer technique, resonant frequency technique, mechanical sonic and ultrasonic pulse velocity methods, or a combined method of the two latter techniques. Advanced techniques could be useful to investigate some particular information. For determining depth of concrete cover or the location of the reinforcement bars, Pachometer or cover meters magnetic methods could be used. To measure the moisture content and

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<sup>80</sup>William Coney and Janey Wiss, *Preservation of Historic Concrete: Problems and General Approaches*, *Preservation Briefs*, no. 15, p. 5.

<sup>81</sup>ACI Committee 201. Guidelines for Making a Condition Survey of Concrete in Service, 1984.



thickness of concrete, electrical methods (Dielectric measurements, electrical resistivity probes) or microwave absorption techniques could be considered. For the study of the initiation and growth of cracks in concrete, Acoustic Emission Techniques should take place.<sup>82</sup>

If more detailed examinations are required, laboratory testing can be invaluable in determining the composition and characteristics of concrete and in formulating a compatible design mix for repair materials. Strength, alkalinity, carbonation, porosity, alkali-aggregate, and presence of chlorides should be investigated.<sup>83</sup> Chemical analysis, microscopic and petrographic examination, visual inspection of the samples, and the concrete/mortar surrounding extraction of the core sample are the main testing procedures that should be conducted. However, the results of these tests could be non-representable of the general condition of the concrete due to the heterogeneity of the material. Consequently, a fair amount of carefully selected samples are required. According to a study presented by Perkins, in 1986, no published recommendations that can guide to determine the number of cores required to enable a reasonable assessment to calculate the strength of the concrete or

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<sup>82</sup>For a complete account of the different nondestructive testing for concrete see Malhotra, V. Testing Hardened Concrete: Nondestructive Methods, American Concrete Institute: Detroit, Michigan, 1976. This book is a review of nondestructive in situ testing techniques, stating their field uses, their advantages and their limitations. The monograph has been prepared for engineers engaged in the evaluation of quality of hardened concrete. A brief table-like comparison between different tests stated in this monograph is included in Appendix II.

<sup>83</sup>See Clear and Harrigan, E. T, Report No. FHWA-RD-77-85: Sampling and testing for Chloride ion in Concrete, Federal Highway Administration, Offices of Research & Development, Washington, D.C. 20590, August, 1977. The research is addressed towards concrete bridge decks and marine structures, considering the damage caused by chloride ion which induced reinforcing steel corrosion. However, it could be useful if the concrete-building investigation is done in Alexandria (sea port city) . The study introduces alternate procedures for sampling the hardened concrete with either core drill or a rotary impact drill. In addition two alternate methods of chemical analysis are presented, the original titration method (using 0.01N AgNO<sub>3</sub>), and the Gran endpoint determination procedure (titration to 225 mv  $\pm$  5 Cl<sup>-</sup> electrode or 310  $\pm$  5 mv Ag<sup>+</sup> electrode). Part two contains the complete sampling and testing method for determination of total chloride ion content. Part three contains the sampling and testing method for water-soluble chloride ion content. The last part of the study discusses the accuracy and the repeatability of the methods comparing to the two other alternate sampling procedures. For our interest, the Sampling procedure could be summarized in two steps: I. Determine the depth within the concrete (usually according to the reinforcement bars location and depth determined by a pachometer), II. Follow the Core Method (drill the core to chosen depth and retrieve) or the Pulverizing Method (using a rotary hammer depth indicator).





the average cement content. Nevertheless, for the mix proportions test, determination of chloride content, chemical analysis, the author recommends to follow the table 7 of BS5328:1981, the Building Research Established Information Sheet IS.13/77, BS5328 respectively, to determine the required samples.<sup>84</sup>

The analysis should focus on determining the nature and causes of the concrete problems, on assessing both short-term and long-term effects of the deterioration, and on formulating proper remedial measures.

In addition to the previous testing one should consider other analysis that deal with the evaluation of the compatibility of a new prepared mix to match with the existing concrete. Two main studies are reviewed: A. M. Neville's (1963) and W. H. Taylor's (1965).<sup>85</sup> Although both studies directed their testing to the analysis of the existing concrete only to improve properties of a newly constructed one, these analytical procedures could have a major role to determine the preservation intervention. For the purpose of our study, selected tests will be listed as following: Abrasion and Erosion test; Cement Content; original water/cement ratio; Compressive, tensile, flexural and bond tests; Curing efficiency test; Dryness test; Durability tests (rapid, chemical, Weathering tests); Fatigue and impact resistance; Permeability and absorption tests; Proctor Hardening test. In addition to the previous tests, one should consider color matching tests.<sup>86</sup>

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<sup>84</sup>Perkin also recommends 50 mm diameter cores for the mix proportions test. While for the Petrographical tests, Perkins recommends to connect it with suspected alkali-aggregate reaction zones in the concrete surface, for the microscopic examination, the author only dictates a careful preparation of the thin section. Philip Perkins, Repair, Protection and Waterproofing of Concrete Structures, Elsevier Applied Science Publishers: New York., 1986, pp. 283-284. See British Standards Institution, BS5328— *Methods of specifying concrete including ready-mixed concrete*, 1981 and *Building Research Established Information Sheet IS.13/77*.

<sup>85</sup>see chapter 14 'on testing' pp. 209-224, in Taylor, Concrete Technology and Practice, New York: American Elsevier Publishing Company, Inc., 1965, and chapter on testing of hardened Concrete pp. 385-439, in Neville, Properties of Concrete, New York: John Wiley & Sons, Inc., 1963.

<sup>86</sup>Although the studied analysis could be addressed in the preservation even by testing the historic concrete or by evaluating the compatibility of a new prepared mix to match with the old structure, no color matching testing is described. We believe that the reason is that engineers (the majority concrete's authors) believe that concrete is only a structural material. They do not admit that concrete could be left unfinished, and a protective coating should always be applied on the surface.



## Appendix I

### Auguste Perret: Building list



## Auguste Perret: Building list

The following building list is generated based on:

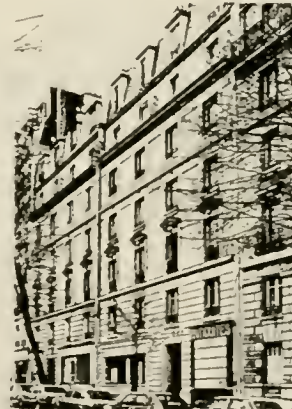
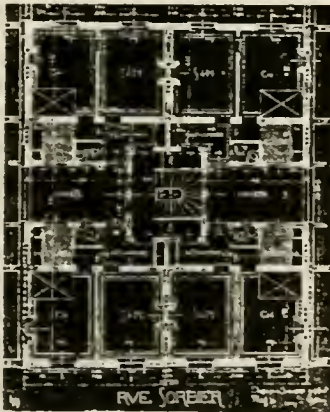
- 1 Perret's building list in Paul Jamot, A.-G. Perret et L'Architecture du Béton Armé, G. Vanoest (editor), Paris: Librairie Nationale d'Art et d'Histoire, 1927, pp. 89-90.
- 2 Perret's building list in Bernard Champigneulle, Perret, Paris, Arts et Métiers Graphiques, 1959, p. 150.
- 3 Published articles that could attribute a certain building to the Auguste Perret architect. For example: Arakel Nasar Bey house (1932) which was attributed to Perret by Marie-Pierre Toll in her article *Where beauty is not a luxury. (E and Q Khanh restore an A Perret house)*, House & Garden 156:130-9+ September 1984.
- 4 Perret's building list in Giovanni Fanelli & Roberto Gargiani, Auguste Perret, Editori Laterza, 1991, p. 188-194.<sup>1</sup>
- 5 The author's own observations to the Perret's work in Alexandria.
- 6 Some building's datings were corrected according to some proofs demonstrated in latter published articles. For example Joseph Abram claimed that 1905 is a wrong date of the Garage rue Ponthieu, and proved that the date of the first Perret's drawing to the garage was dated to 1907. J. Abram, *Un savoir urbain implicite: les immeubles de rapport des frères Perret*, Les Cahiers de la recherche architecturale: L'Immeuble, No. 22, first trimester, 1988, p. 62 and note no. 45, p. 65.

Notes:

(\*) indicates the buildings that have been constructed, but not designed, by the Perrets  
The italics entries are the projects that had not been executed.

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- 1-1889, Tour du Temple (A. G. Perret worked with their father only in the construction), Universal Exhibition at Paris.
- 2-1889, Family summer residence, Ravin Cottage, at Berneval-sur-Mer, near Dieppe. A. Perret executed the plans, demolished in 1944. (Illustrated in Fanelli fig. 1).
- 3-1890, Maison à Berneval, Berneval-sur-Mer.
- 4-1890, *Project of a Casino, Berneval-sur-Mer.*

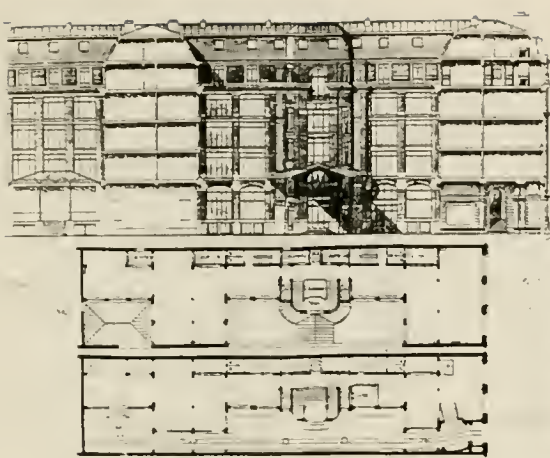


- 5-1894-1896, Quatre Immeubles Mitoyens, property of François Granddidier, 32-34 bis Rue Sorbier, Paris 20<sup>e</sup>. (Fanelli, fig. 13-14)
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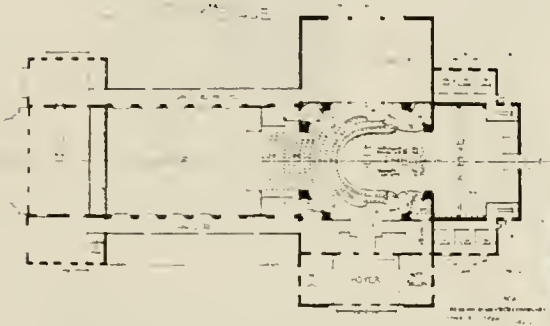
<sup>1</sup>I find Fanelli and Gargiani's building list the most extensive and complete for Perret's work. The authors at the end of this building list, inscribes 8 undated projects that Perret was involved with. These 9 projects are not included in my list. See Fanelli, p. 194.



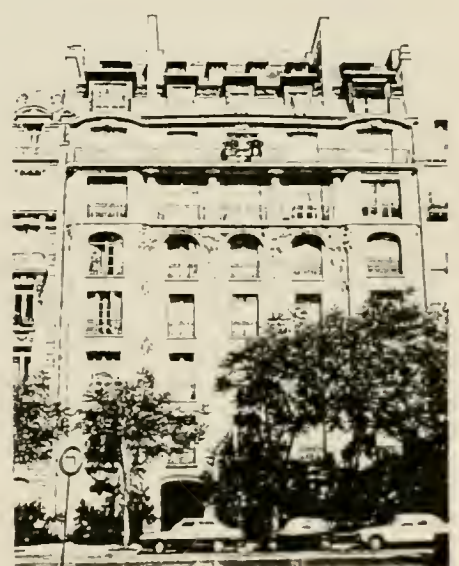
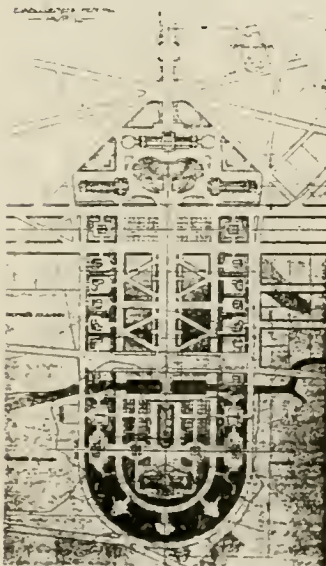




6-1897, Immeuble pour bureaux, 10, rue Faubourg Poissonnière, Paris 10<sup>e</sup>. (Abram, *Les Cahiers*, p. 56; Fanelli, fig. 15, 16)



7-1898-99, Casino Municipale, Quai Dugay-Tourin, chaussée du Sillon, Saint-Mallo, demolished in 1945. (Abram, *construction*, p. 83; Champigneulle p.12.)

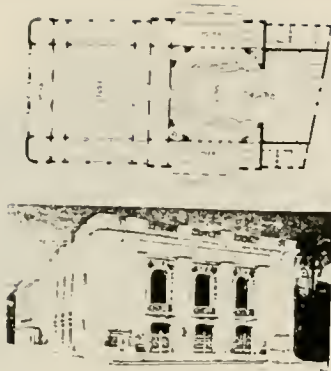


8-1901, Study project of Un établissement thermal à Avril-sur-Loire, Presented to the diplome competition. (Fanelli fig. 19-21).

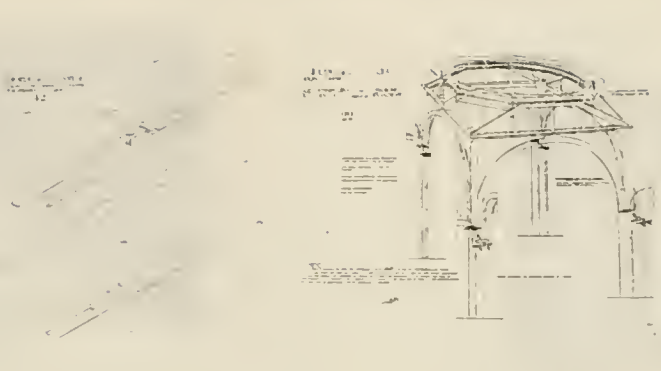
9-1902, Immeuble à loyer du 119, avenue de Wagram, Paris 17<sup>e</sup>. (Abram, p.57)



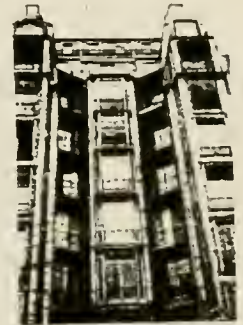
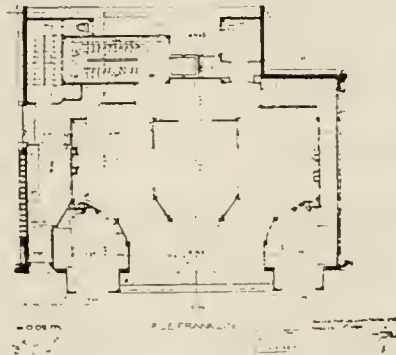
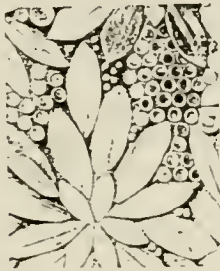




10-1902, Theatre for Oran, Algeria.  
(Fanelli, fig. 22, 33)



11-1902-1908, Construction of Oran Cathedral,  
Algeria, designed by Albert Ballu. (Fanelli fig. 39, 40)



12-1902-03, Immeuble 25 bis rue Franklin, Paris. (Abram, p. 59; Champigneulle p.17)

13-1902, Cercle d'escrime Hoche, 11, avenue Beaucour, Paris.

14-1904, temporary structure for the Ecole de la rue de la Tour, 44 rue de la Tour, Paris. (wood, fibre-cement and plaster)

15-1904, Immeuble de rapport, 83, avenue Niel, 48-50 rue Rennequin, Paris 17<sup>e</sup>, Property of Louis Bernard. (steel and stone)

16-1904, Villa de M. Bonnet, Montereau, near Maux. (wood)

17-1904-05, the extension of the Hôtel particulier Yvanhoé Rambosson, 6 rue de l'Armée d'Orient, Paris. (Fanelli, fig. 37)



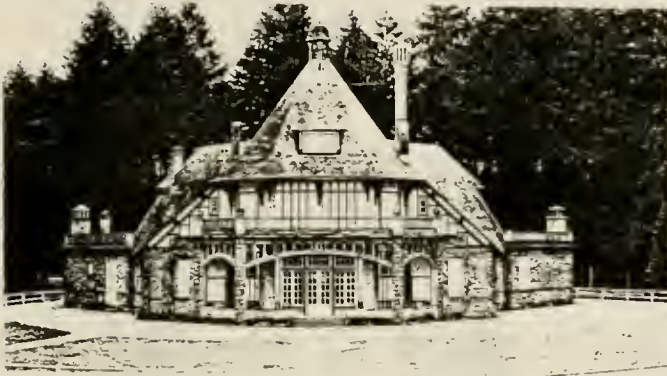
18-1906, Immeuble de rapport, 48, rue  
Raynouard, Paris 16<sup>e</sup>. (Abram, p. 62)



19-1906, sanatorium project, Treleven, Côtes-  
du-Nord. (Fanelli, fig. 38)



20-\*1906, The construction of Algeria Pavillion designed by Albert Ballu, Marsillia Exposition.



21-1907, La Saulot, rendez-vous de chasse à Salbris pour M. Lange Salbris, Loir-et-Cher. (Fanelli, fig. 44)

22-1907-08<sup>2</sup>, Garage at 51 rue Ponthieu, Demolished in 1970. (Collins, *The Doctrine*, p.93)

23-1907-08, Docks à Saïda, Tiaret at Sidi-Bel-Abbès, Algeria.

24-\*1908, the construction of an Hôtel Particulier, Paul Guadet architect, 8 avenue Elisées-Reclus. (Fanelli, fig. 125)

25-\*1908, the construction of the Algeria Pavillion, Albert Ballu architect, Franco-Britannique exposition, London.

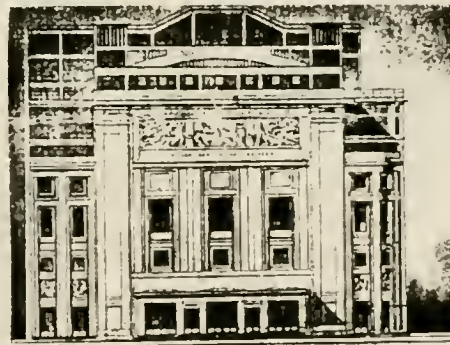
26-\*1908-10, the construction of the Voyages et Travaux d'entreprise, French Legation, Paul Guadet, architect, Gettigne, Monténégro, légatin de France.

27-\*1908, the construction of the French Legation, Georges Chedanne architect, Bruxelles.

28-1908, project for a Maison bouteille.

29-\*1908-10, the construction of the transformation work of the France embassy in Constantinople, Turkey, Georges Chedanne architect. (extensive use of reinforced concrete in the transformation work)

30-1909-10, the interior and exterior transformation of Paul Jamot's countryside house. Bièvres, Essone. (the interior is illustrated in Jamot. pl. XXXVII, p.62)



31-1911-1913, Théâtre des Champs-Élysées, 15 avenue Montaigne, Paris. (Collins, *The Doctrine*, p.93)

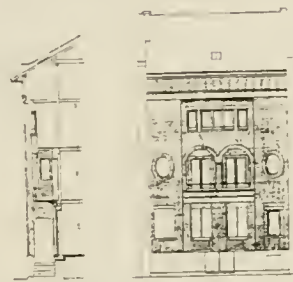
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<sup>2</sup>Joseph Abram claimed that 1905 is a wrong date of the Garage rue Ponthieu construction, and he accused Paul Jamot as the responsible of that. He also proved by looking to the archival documents at CNAM, that the date of the first Perret's drawing to the garage was dated to 1907. J. Abram, *Un savoir urbain implicite: les immeubles de rapport des frères Perret*, *Les Cahiers de la recherche architecturale: L'Immeuble*, No. 22, first trimester, 1988, p. 62 and note no. 45, p. 65.





- 32-1912, Atelier for Maurice Denis, 2bis rue Maurice-Denis, Parc du Prieuré, Saint-Germain-en-Laye, Yvelines.
- 33-1912-13, the construction of the Hôtel Particulier Guadet, Paul Guadet architect, 95 boulevard Murat, Paris
- 34-1912-13, Office of the conservationist Renée Maubel, 4-4bis rue de l'Armée d'Orient, Paris. (Fanelli, fig. 62)



- 35-1914-21, Monument de Mme Paul Jamot at cimetière Montparnasse, allée Raffet, . 25th division, ParisCher. (Jamot, pl. XX)
- 36-1914-15, Hôtel Particulier for the painter Théovan Rysselberghe, 14 rue Claude-Lorrain, Paris. (Fanelli fig. 63)

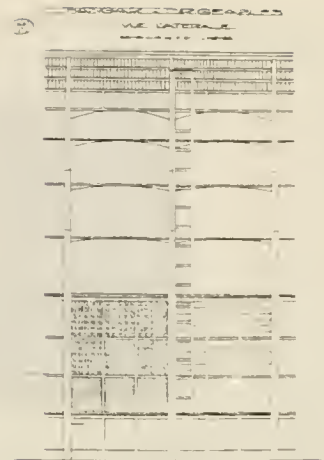
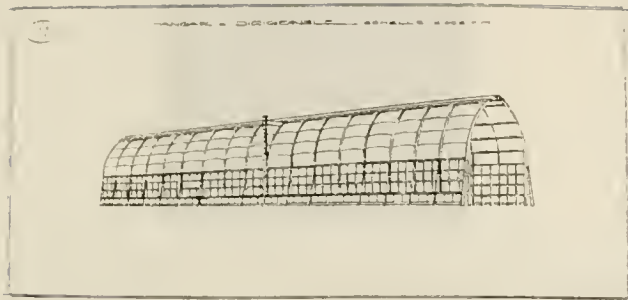
37-1914, *Project for the Royal Society of Harmonie, Chaussée de Malines, rue de la Pèpinière, rue de l'Harmonie, Anvers.*



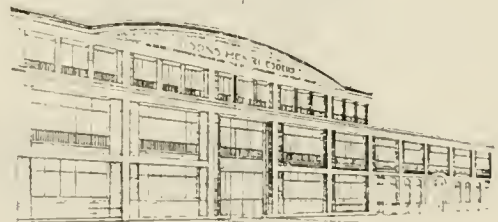
- 38-1915-16, Docks de Casablanca, Morocco. (Jamot, pl. XXXII; Fanelli)
- 39-Chapelle chez Maurice Denis, Saint-Germain, Paris.







- 40-1917, *Project for the Société de Navigation Aérienne, Bizerte, Tunisia.* (Fanelli, fig. 69-71)  
 41-1918-19, (1921)<sup>3</sup>, *Rozanes jewellery shop, Corner of rue de la Paix and rue des petit-Champs, Paris.*  
 42-1919, *Project of a single family, one floor house, Casablanca.*  
 43-1919, *Docks de la Société industrielle at Casablanca, Morocco.*



- 44-1919 (1923)<sup>4</sup>, *A tailor headquarter for Henri Esders, 75-77 avenue Phillipe-Auguste, Paris, demolished around 1960. Perret's first attempt for floor prefabrication.* (Champigneulle p. 39 Fanelli fig. 73, 74.)  
 45-1919, *Atelier Voirin, Montataire, Oise.*  
 46-1919-20, *the gallery of Saint-Louis chapel, 2bis rue Maurice Denis, Saint-Germain-en-Laye.*  
 47-1919-21 (1923-1927)<sup>5</sup>, *Ateliers Marinoni, Montataire, Oise.* (see Champigneulle p. 39)  
 48-1919-21, *Ateliers Fonderie Wallut, Montataire, Oise.*  
 49-1919-21, *Fonderie Grange, Montataire, Oise.*  
 50-1920, *Department store of the Paris-Maroc society, Rue de Libourne, Casablanca.*

<sup>3</sup>Champigneulle dates this building to 1921, he also specifies it as jewellery shop.

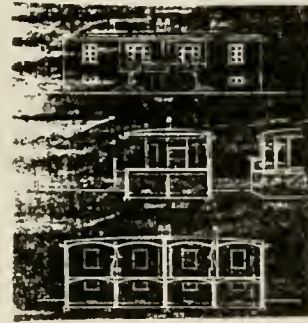
<sup>4</sup>Champigneulle dates this building to 1923.

<sup>5</sup>Champigneulle claims that this atelier was built in the period between 1923 and 1927 in his notices (p. 143). Then he dated the building to 1920-21 in his Perret's biography (p.150). Bernard Champigneulle, *Perret*, Paris, Arts et Métiers Graphiques, 1959, p. 143 & 150. However Jamot's dating to this atelier is 1919-21. Paul Jamot, *A.-G. Perret et L'Architecture du Béton Armé*, G. Vanoest (editor), Paris: Librairie Nationale d'Art et d'Histoire, 1927, p. 90. Comparing the books' publication date and the construction date of the building, one should agree with Jamot's dating more than Champigneulle's.



51-1920, *Project of an Aéroplanes-hangar for the Service de la Navigation Aérienne.*

52-1920, a Factory and the extension of the 'rendez-vous de chasse' La Saulot, Salbris, Loir-et-Cher.



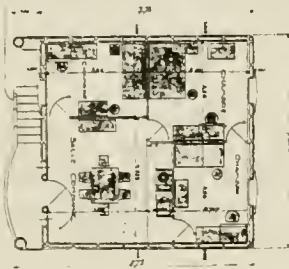
53-1920, *Project of Maisons ouvrières.* (Fanelli fig. 110)

54-1920-21, the construction of the Magasins Modernes, unknown architect, Place de France, Casablanca, Morocco.

55-1920-21, Hamelle Shop, Route de Rabat, Casablanca, Morocco.

56-1921, F.E.R. factory, Aulnois. (Jamot's building list)

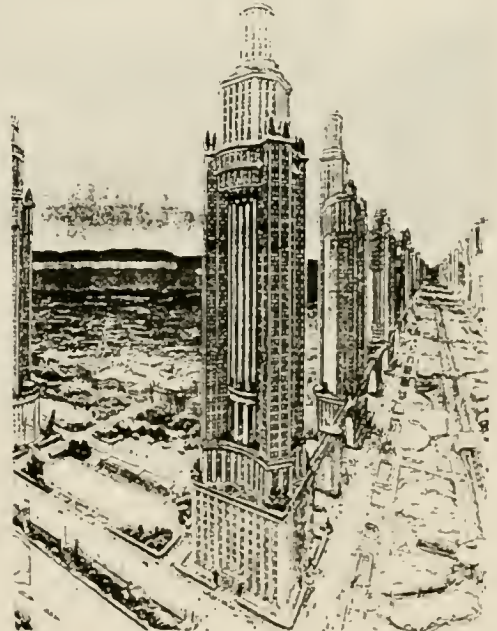
57-1921, Office for the Perret Frères, Boulevard Circulaire, Casablanca, Morocco.



58-1921, "maisons en série". Published in *Esprit nouveau*, no. 13. (Fanelli, fig. 111, 112.)

59-1921, A project of a Hangar for the Service Technique de l'Aéronautique, Ministry of public work, Villacoublay, Yvelines. (see Fanelli fig. 72)

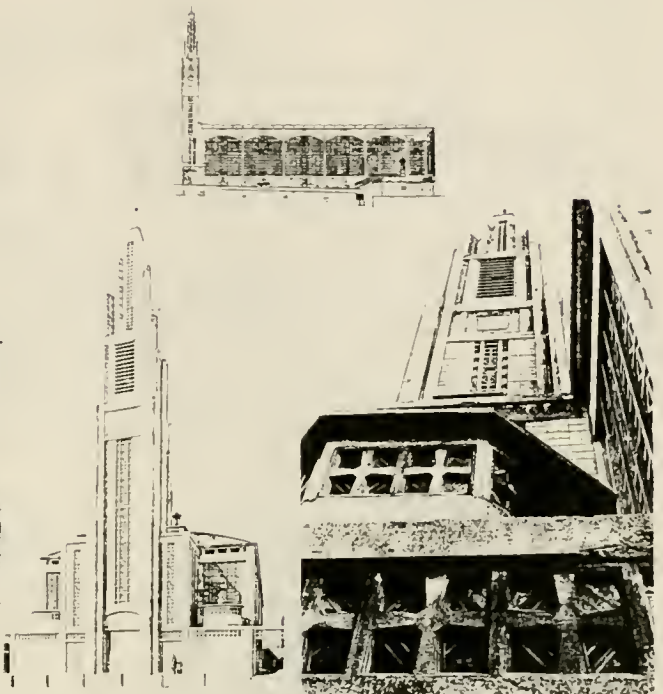
60-1922, project for "Maisons-Tours". Published in *Illustration*, August 12, 1922, and in *Science et la Vie*, December 1925. (Fanelli, fig. 105.)





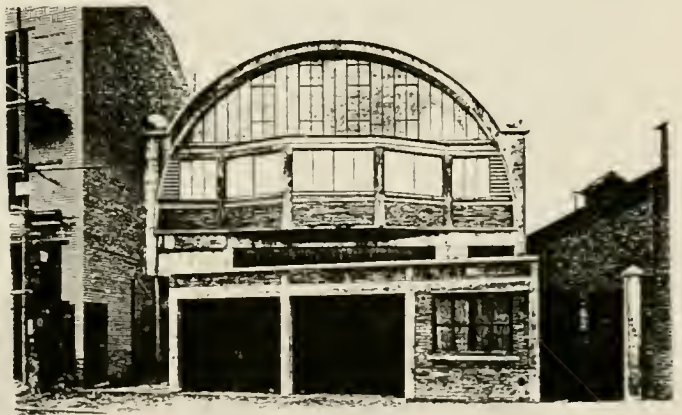
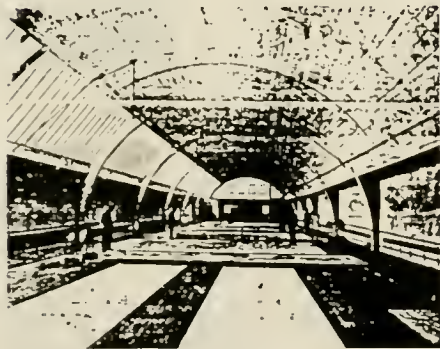


61-1922, Société marseillaise de crédit, 4 rue Auber. (large use of reinforced concrete)



62-1922, Residential complex, A. André Fils company, Grand-Quevilly, near Rouen.  
(see Fanelli fig. 115-117)

63-1922-23, Notre Dame du Consolation Church  
83 avenue de la Résistance, Le Raincy.  
(see Jamot, pl. XXV; Fanelli fig. 78-86)



64-1922, Atelier Durand for decoration paintings, 47 rue Olivier-Métra, Paris XX<sup>e</sup>. (see Champigneulle p.36; Fanelli fig, 75, 76)

65-1923, Maison à Grand-Quevilly, Grand-Quevilly, near Rouen.

66-1923, Le pont d'argent, constructed for the Petits Lit Blancs festival. Theatre de Champs-Élysées.

67-1923, Pavilion of the first exhibition of the Salon de Tuileries, Tuileries Park, Paris, demolished. (Fanelli's building list)

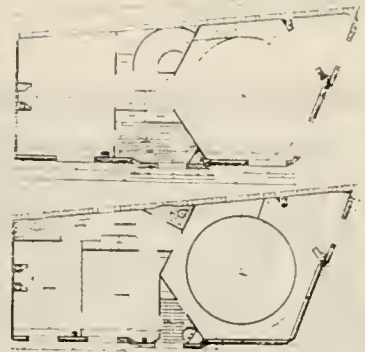
68-1923, the redesign of the Hôtel Particulier Rozanes, 46 rue Poussin, Paris, demolished.



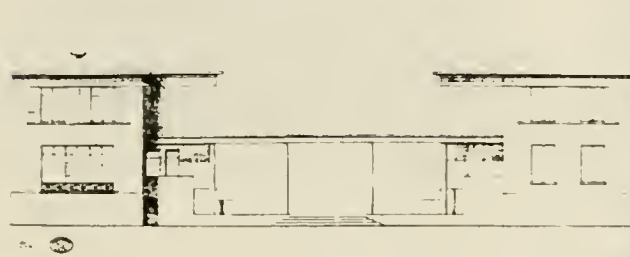




69-1923-24, Transformation of the Hall de la Société marseillaise de crédit, rue Auber (Jamot, pl. XXXV)



70-1923-24, Hôtel Particulier M. Gaut, 2 park Montsouris, rue de Nansouty. (Fanelli fig. 118-120)



71-1923-26, Service building; pavillion; stable; and projects for gardener house and gaz tank, Baillon Castle, near Chantilly, avenue San-tiago-Soulas. (Fanelli fig. 126, 127)

72-\*1923-27, the construction of the Hôtel particulier, E. Mottini architect, Neuilly-sur-Seine.



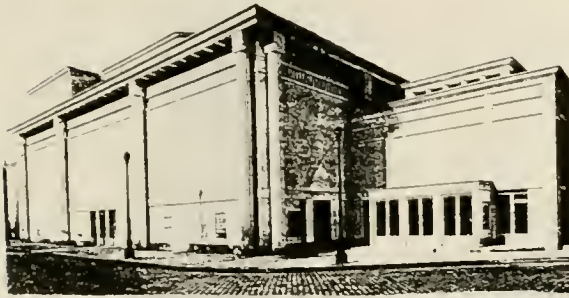
73-1924, The restoration of "Le Clocher de Saint-Vaury", Creuse. The bell tower after and before restoration. The cockof the bell tower by Pompon(Jamot, pl. XXXIV)



74-1924, Le Palais de bois, for the Société d'artistes, Salon des Tuileries, Boulevard Lannes, Porte Maillot, Paris, demolished in 1928. (Jamot, pl. XXXIX)



- 75-1924, the construction of a theatre, Auguste Bluysen architect, 4 rue de la Michodière, Paris.  
 76-1924, the construction of Henri Esders shop, M. Henrion and E. Berthelot architects, 122-126 rue de Rivoli, Paris.



77-1924-25, Théâtre de l'Exposition des Arts Decoratifs, the Exposition of the Decorative Arts. Demolished after only few months of its erection. (Fanelli, fig 98)

78-1925, Le Pavillon Lévy (Samaritaine afterwards), at the Exposition of the Decorative Arts, demolished 1925. (Fanelli fig. 104)

79-1925, Le Crédit national hôtelier. (transformation of an 'immeuble' to a bank), rue de la Ville l'Evêque.

80-1924-25, The Tour of Grenoble (95.5 m., 7.95 of diameter), at the International Exposition of decorative arts, Grenoble. (Fanelli fig. 92)

81-1924-25, the redesign of Paul Poiret's appartement and the Martine studio, Rond-Point des Champs-Élysées, Paris.

82-1925, Loraine factory, 151 avenue du Président-Wilson, La Plaine Saint-Denis.

83-1925, Copeau factory (Gras and Sackiteder properties), 151 avenue de la République, Bagnolet, Seine-Saint-Denis.

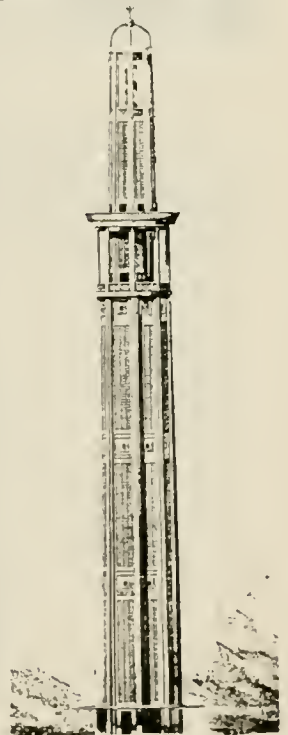
84-1925, Auto-Accessories factory, 19 rue Ibry, Neuilly-sur-Seine, Hauts-de-Seine.

85-1925, Project of Saint-Joseph chapel and church, Dijon. (see Fanelli fig. 80)

86-1925, Project of an office and residential building, Clement Bayard, property, 4 rue Berteaux-Dumas, Neuilly-sur-Seine.

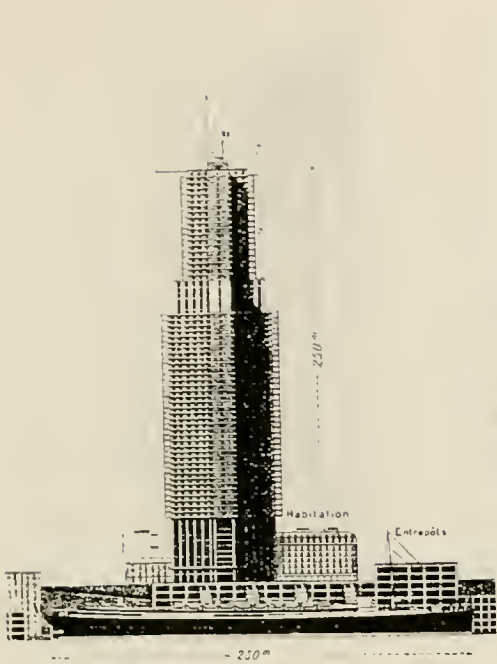
87-1925, Project of an immeuble de rapport at Perret's property, 51-55 rue Raynouard, Paris.

88-1925, Office building for the Crédit National Hôtelier, 3 rue de la Ville-l'Evêque, Paris. Modified in 1989





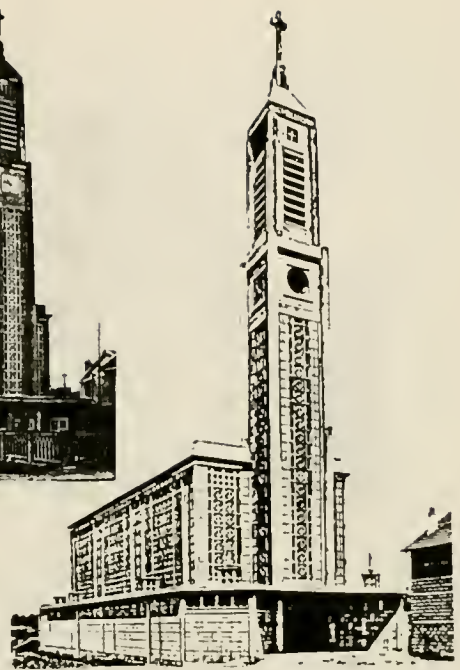




89-1925, project of Maison-Tours,  
(Fanelli, fig. 107)



90-1925-26, Eglise Sainte-Thérèse  
Rue d'Epinay, Montmagny, Val-d'Oise, near Saint  
Denis Decorative Arts, demolished 1925.  
(Champigneulle p.43, Fanelli, fig. 87)



91-1925-27, the construction of an office building and a pavilion at the Museum d'Histoire  
Naturelle complex, unknown architect, Jardins des Plantes, rue Poliveau, Paris.



92-1926, Hôtel Particulier M. Adolphe Mouron, 11 rue Albert-Joly Versailles. (Fanelli fig. 121,  
see also Jamot, pl. XXXVII for the interior)

93-1926, Maison Vêret, Noyon.

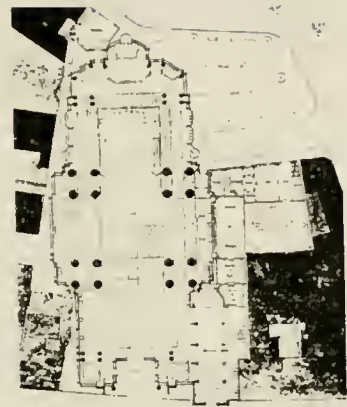
94-1926, Galerie Katia Granoff, 166, Boulevard Haussmann.



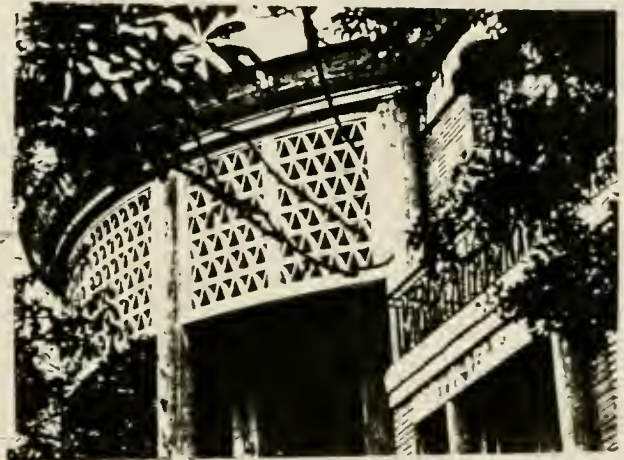




95-1926, Maison de Madame Chana Orloff,<sup>6</sup>  
Rue de la Tombe Issoire.<sup>7</sup> (Fanelli, fig. 134)



96-1926, Project presented to a competition of  
Saint-Jeanne d'Arc chapel . (200 m. clocher),  
Place de Torcy, rue de la Chapelle, Paris.  
(Champigneulle p.49. Fanelli fig. 90)



97-1926, Hôtel Particulier Gustave Aghion, Alexandria, Egypt. (see Fanelli fig. 130-133;  
Marcel Mayar for a photograph; *l'architecture d'aujourd'hui*, April 1937, p. 51 for the  
landscape design; the author's own photographs)

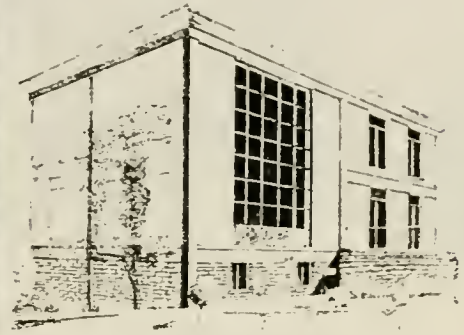
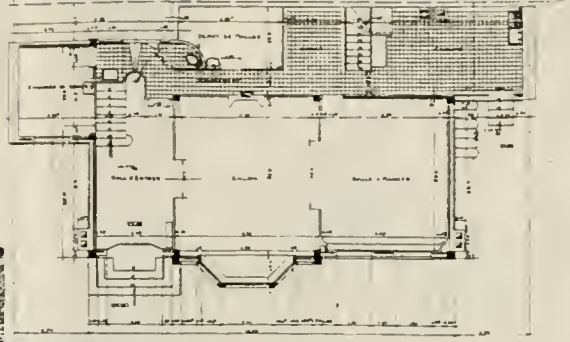
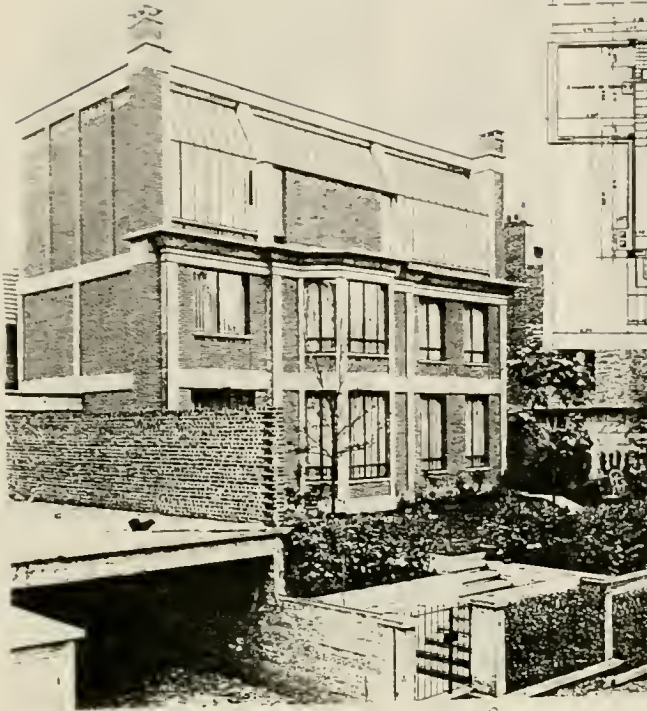
98-1926, Factory of cabinet-maker, Gentilly, Val-de-Marne.

99-1926, Project of Salon des Tuileris office building, Avenue de Neuilly, Paris.

<sup>6</sup>Champigneulle addresses an Sculpture Atelier as the function of this building. Bernard Champigneulle, *Perret*, Paris, 1959, p. 145. However in his text he states that it was a 'maison' (p. 65)

<sup>7</sup>Fanelli provides '7bis villa Seurat, Paris' as the address of the Chana Orloff's studio.





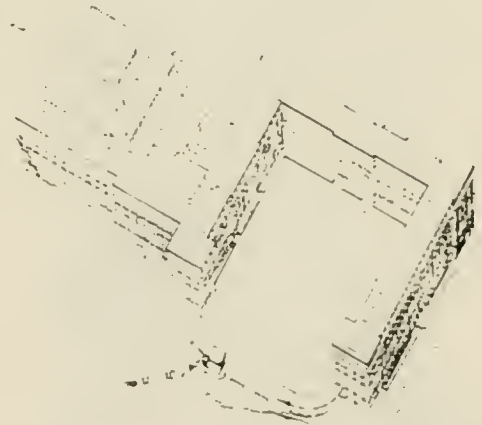
100-1927, Maison Georges Braque, 6 rue <sup>8</sup>  
Georges-Braque, Paris. (Fanelli, fig. 138  
; fig. 139, plan)

101-1927, Project of Marc Chagall house and  
studio, Bellevue Hauts-de-Seine. (Fanelli  
fig. 141)

102-1927, Greenhouse in the Barone Fould Castle complex, Royaumont, Val-d'Oise.

103-1927, Project of a chapel, 21 rue Blanche, Paris.

104-1927, the redesign of the appartement of André Gide, Rue Vaneau, Paris.



105-1927, project of the Palais des Nations. Genève. (Champigneulle p. 73, Fanelli, fig 146, 147)

106-1927<sup>9</sup> project for a Couvent de dominicaines , Cairo, Egypt. (Champigneulle and Fanelli  
building lists)

107-1927, Lycée de jeunes filles, Constantine.

<sup>8</sup>Champigneulle's address is 'Rue Douanier'

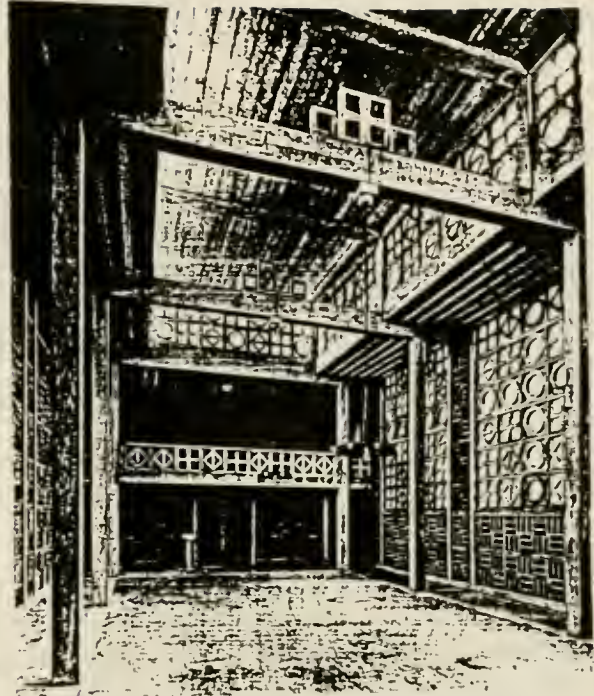
<sup>9</sup>Fanelli dates this project to 1930-32.







108-1927-28, Maison Bresy, 27 Villa Sal d,  
Paris. Champigneulle p. 70, see also  
Mayer p. 1 and Fanelli fig. 145



109-1927-28, Chapelle d'Arcueil, 52 avenue  
Laplace, Arcueil, Val-de-Marne.  
(Champigneulle p.46)

110-1927-28, *Project of a chapel, Convent of Le Rosier de Saint-François., 80 Faubourg  
Montmélian, Chambéry, Savoie.*

111-1927-30, the extension of the Marinoni factory, Montataire, Oise. (see Mayar for an interior  
photograph)



112-1928, *project of a seminar, Paris.*  
(Fanelli fig. 148)



113-1928, *Project for the Salon de Tuileries  
office building, Boulevard Lannes, Porte  
Maillot and Pont Lalo, Paris. (Fanelli's biog.  
fig. 97)*

114-1928, Pavillon and aviary, Pierre Gaut yard, Avenue du Calvaire, Sceaux, Hauts-de-Seine.

115-1928, *Project of a building, rue Villiers de l'Isle-Adam, Paris.*







116-1928-29, Maison Mela Muter, Villa Seurat, 6 allée Maintenon, in 114bis rue de Vaugirard, Paris. (Fanelli fig.143)



117-1928-31, Office building for the Service Technique des Constructions Navales, 8 boulevard Victor, Paris. (Fanelli fig. 181)

118-1928-32, Prieuré Sainte-Mathilde buildings, 5-7 rue d'Issy, Vanves, Hauts-de-Seine.

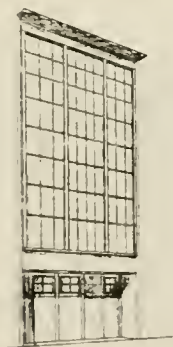
119-1929<sup>10</sup>, Extension of Juvisy-sur-Orge church, Juvisy-sur-Orge, Essone.

120-1929, Monument à Gustave Eiffel (with the collaboration of Emile-Antoine Bourdelle and André Granet), Tour Eiffel, pylone Nord, Champs-de-Mars, Paris.

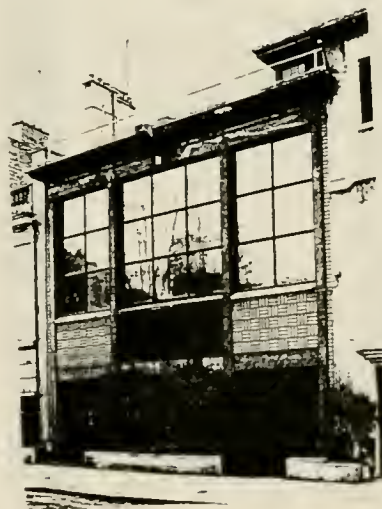
121-1929, Chapelle at the Colombière school, 72 rue d'Autun, Chalon-sur-Saône, Saône-et-Loire.

122-1929, Monument Mayrich, Route de Châlons-sur-Marne.

123-1929, Monument à Colpach, Luxembourg.



124-1929, Maison Marguerite Huré, 25 rue du Belvédère, Bologne-Billancourt, Boulogne-sur-Seine. (Fanelli fig. 142)

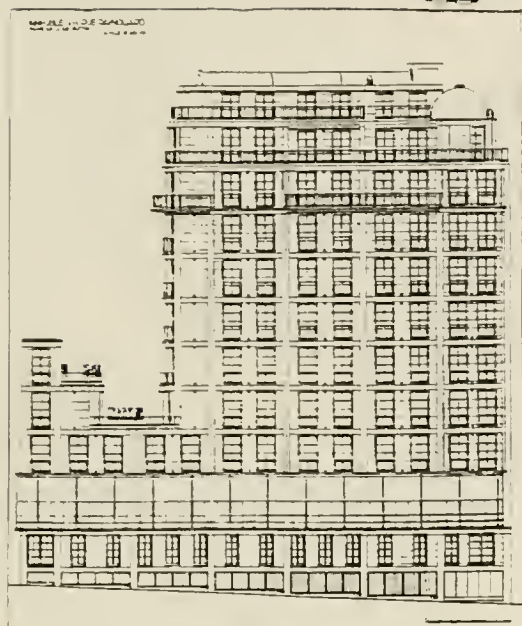


125-1929, Maison Dora Gordine, 21 rue du Belvédère, Bologne-Billancourt Boulogne-sur-Seine. (Fanelli fig. 144)

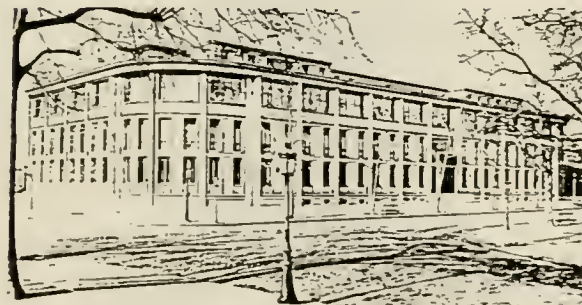
126-1929, Aménagement de la Galerie Katia Granoff, Quai Conti.

<sup>10</sup>Fanelli's date for this church is 1927.

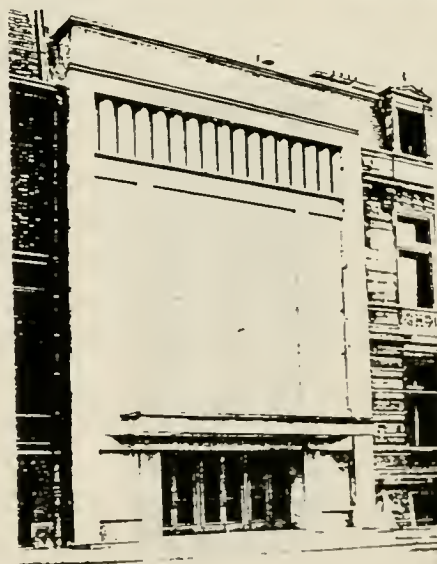




127-1929-32, Immeuble 51 rue Raynouard, Paris. (Champigneulle p. 85, 86)



128-1929-32, the Marine National, 8 boulevard Victor, (Champigneulle p. 81)



129-1929, Concert Hall Alfred Cortot, de l'Ecole normale de musique, 76 rue Cardinet, Paris. (Champigneulle p. 63; Fanelli fig 149)

130-1929, Couvent des Oblates de Saint Benoit.

131-1929, Monigny factory, 21 rue Lucie, Saint-Maur-des-Fossés, Val-de-Marne.

132-1929, the construction of houses for the workers of Marinoni company, J. Nougivenade, architect, Thiverny.

133-1929, Wisner factory, 29 rue de Neuilly, Clichy, Hauts-de-Seine.

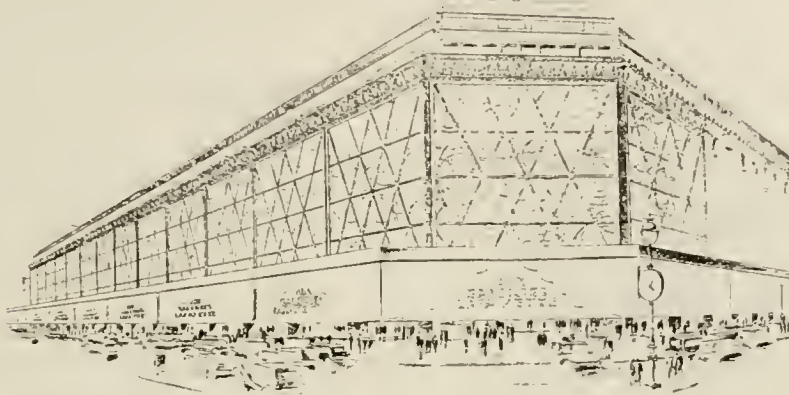
134-1929, Project of an Art Museum, Near the Bois de Boulogne, Paris.





135-1929-30, Maison Maurice Lange, 9 Place de la porte de Passy, Paris. Avenue Ingres. (see Fanelli fig. 166-168)

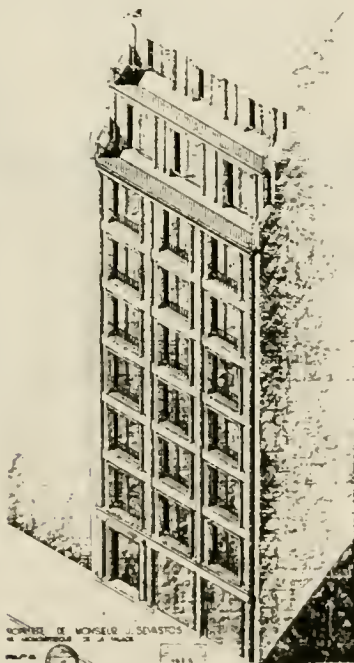
136-1929-35, the construction of the office building of the General Gouvernement of Algeria, Jacques Guiauchain architect, Algeria.



137-1930, project for a façade for the Galeries Lafayette. Chaussée d'Antin, rue de Provence, rue de Mogador, Paris. (Fanelli fig. 186)

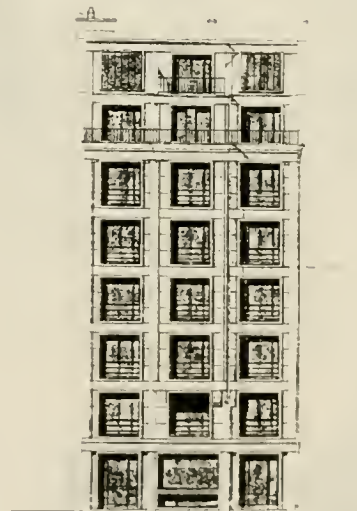
138-1930, project for the Musée Bourdelle..

139-1930, project of a Musée Moderne.



140-1930, Project of an immeuble de rapport, at J. Sevastos property, Rue Ningesser-et-Coli, Paris. (Fanelli, fig. 179)

PROJET DE MONSIEUR J. SEVASTOS  
RUE NINGESSER-ET-COLI  
PARIS



141-1930, Project of an immeuble de rapport, at M<sup>me</sup> Caltier property, 21 rue Eugène - Flachat, Paris. (Fanelli fig. 180)

142-1930, Project of an hôtel particulier for Pol Neveu, Saint-Cloud, Hauts-de-Seine.

143-1930-31, the transformation of the Frères Capucins convent, Saint-Symphorien, Tours.

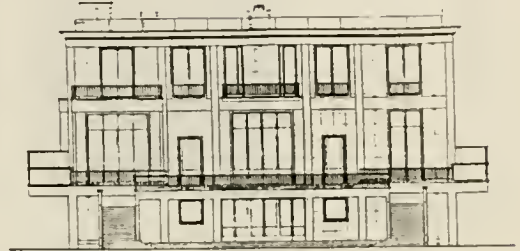
144-1930-31, the transformation of the Musée Magnin, Dijon.

145-1930-31, Project of La Paix Notre-Dame monastery, Amillis, near Coulommiers, Seine-et-Marne.





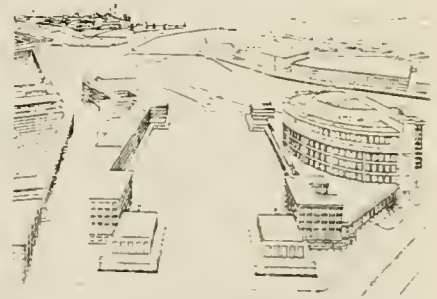
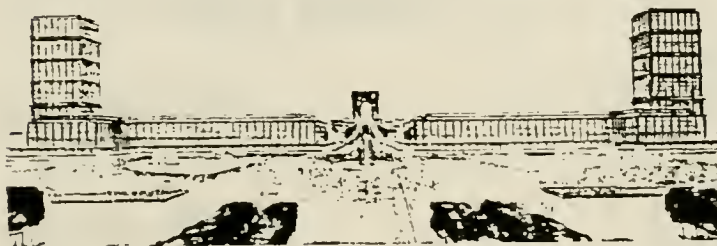
146-1930-31, Project presented at a competition of the Plan of  
Porte Maillot, Porte Maillot, Paris. (Fanelli fig. 191-192)



147-1931, Maison Nubar Arakel Bey, Rue du 19 Janvier, Garches, Hauts-de-Seine.  
(Champigneulle p. 68. Fanelli fig. 169)

148-1931, Société de Travaux de Construction Navales.

149-1931, Chapelle, Bibliothèque of L'Action populaire, 15 rue Raymond-Marcherson, Vanves,  
Hauts-de-Seine.



150-1931, project of the extension of Porte  
Maillot, Place de la Victoire.  
(Champigneulle p. 99)

151-1931, project for the Palais des Soviets.  
Moscow,. (see Champigneulle p. 73 &  
74. Fanelli fig. 193-195)

152-1931, C.P.D.E.. (Champigneulle building list)

153-1931, Project of Bourdelle Museum, Paris.

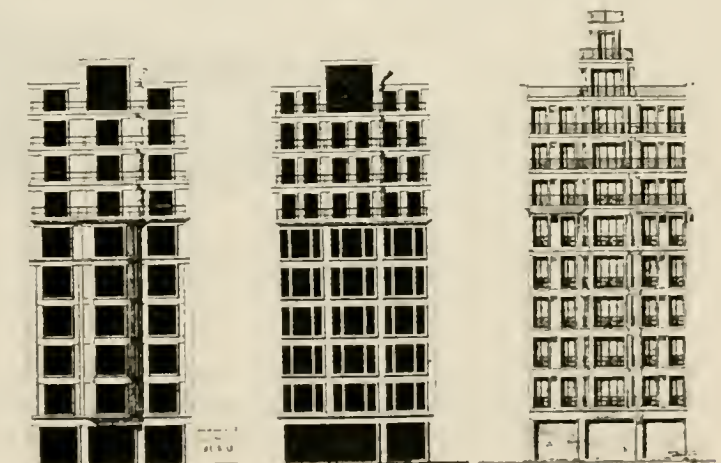
154-1931, Project of Jean Rodier villa, Rue du Mont-Valérien, Saint-Cloud, Hauts-de-Seine.

155-1931, Project of a theatre Hall,  
Boulevard Montparnasse,  
Paris..

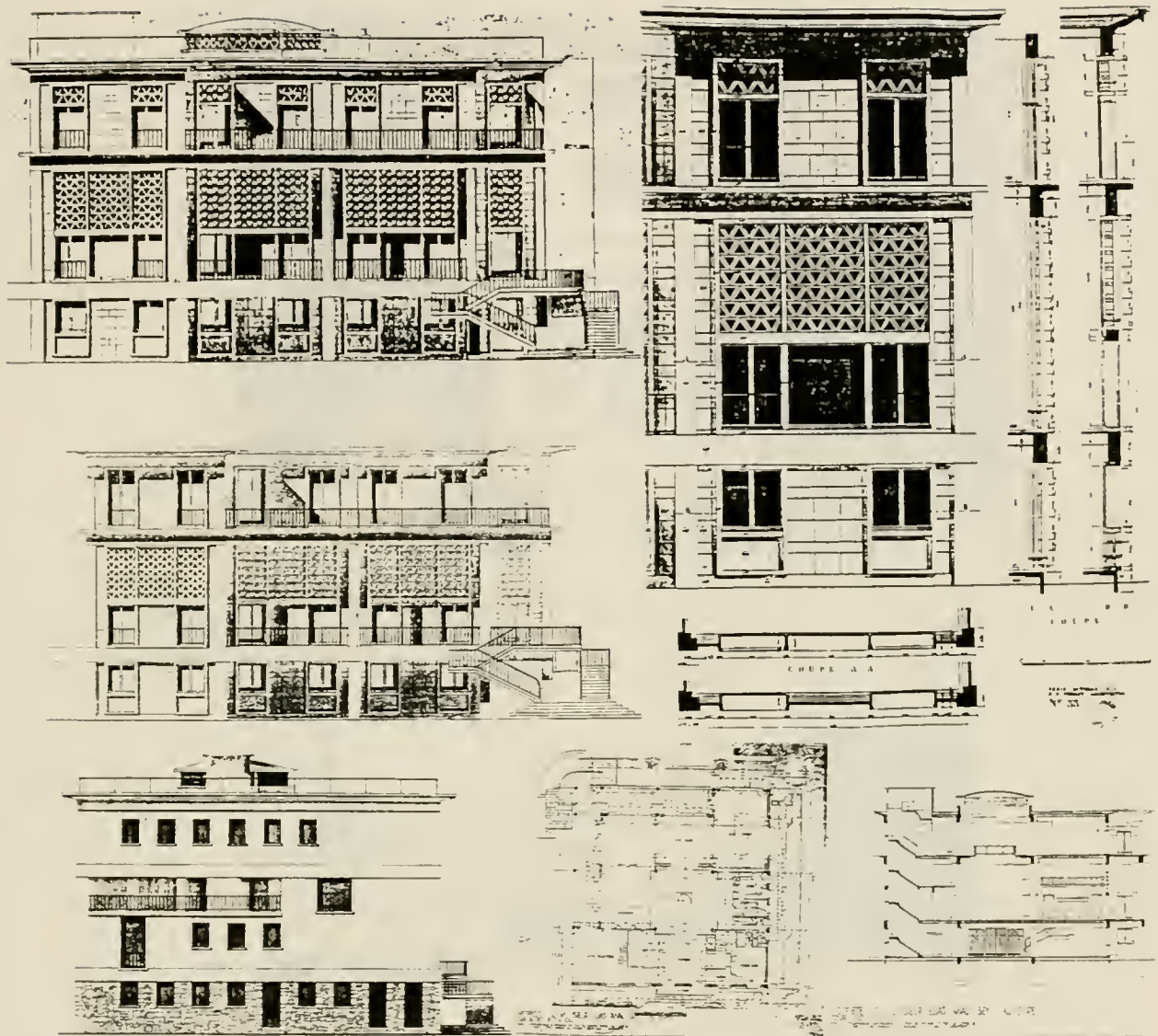
156-1931, the construction of the  
Pavillon of the Société  
Marseillaise de Crédit,  
unknown architect, at the  
International Colonial  
Exposition, Paris.

157-1931-32, Project of an oratory, 9  
rue Mineurs, Strasbourg.

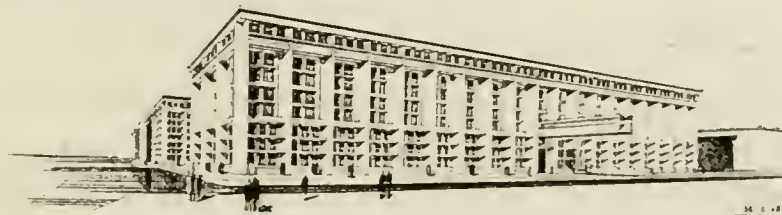
158-1931-33, Project of an immeuble  
de rapport, Auguste Galtier  
property, 3 avenue Matignon,  
Paris. (Fanelli fig. 176-178)







159-1931-32, Maison Awad Bey, Cairo, Egypt.<sup>11</sup> (Champigneulle, p. 69& 134; Fanelli fig. 172-175)



160-1932, project for the Arsenal de Toulon, Toulon. (Fanelli fig. 187-190)

<sup>11</sup>It is not clear from the literature review whether this villa was erected or not. One should note the difference between the two set of Perret's drawings for this villa that are published in both Fanelli (the middle left, and the lower illustrations) and Champigneulle (the upper left and the upper right illustrations)







161-1932, Arakel Nasar Bey house (Emmanelle and Quasar Khanh house, after 1975), 75 rue du Janvier, Les Quatre Vents Hill, Paris.<sup>12</sup> (Marie-Pierre Toll, *Where beauty is not a luxury. House & Garden*, 156, 1984, p. 131.

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162-1932<sup>13</sup>, Mobilier National, 1 rue Berbier-du-Mets, Paris. (Fanelli, fig, 200)

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163-1932, project of a Chapelle, Strasbourg.

164-1932, project for the Cité de la Presse.

165-1932, project of a Cité militaire, Algiers, Algeria.

166-1932, Project for a competition of a parish church, Rue Victor-Desvigne, rue de Verdun, Metz.

167-1932, Project of a residential district at La Cité de la Presse, Montlignon, Saint-Prix, Seine-et-Oise.

168-1932, Restoration of the Marinono factory, 96 rue d'Arras, Paris.

169-1932, Project of a building for the Placement Familial des Tout-Petits, Chevilly ,Loiret.

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<sup>12</sup>Arakel Nasar Bey house is published in Marie-Pierre Toll, *Where beauty is not a luxury. (E and Q Khanh restore an A Perret house)*, *House & Garden* 156:130-9+ September '84. Toll dates it to 1932 which differs it from Nubar Arakel Bey House, 1931 (entry 147). Moreover Toll states that 75 rue Janvier is the address of this building, and that contradicts with Champigneulle's address (19 rue Janvier). However, the exterior photograph published in Toll's article coincides with the drawings of Nubar Arakel Bey House, 1931. (compare entry 161 and 147)

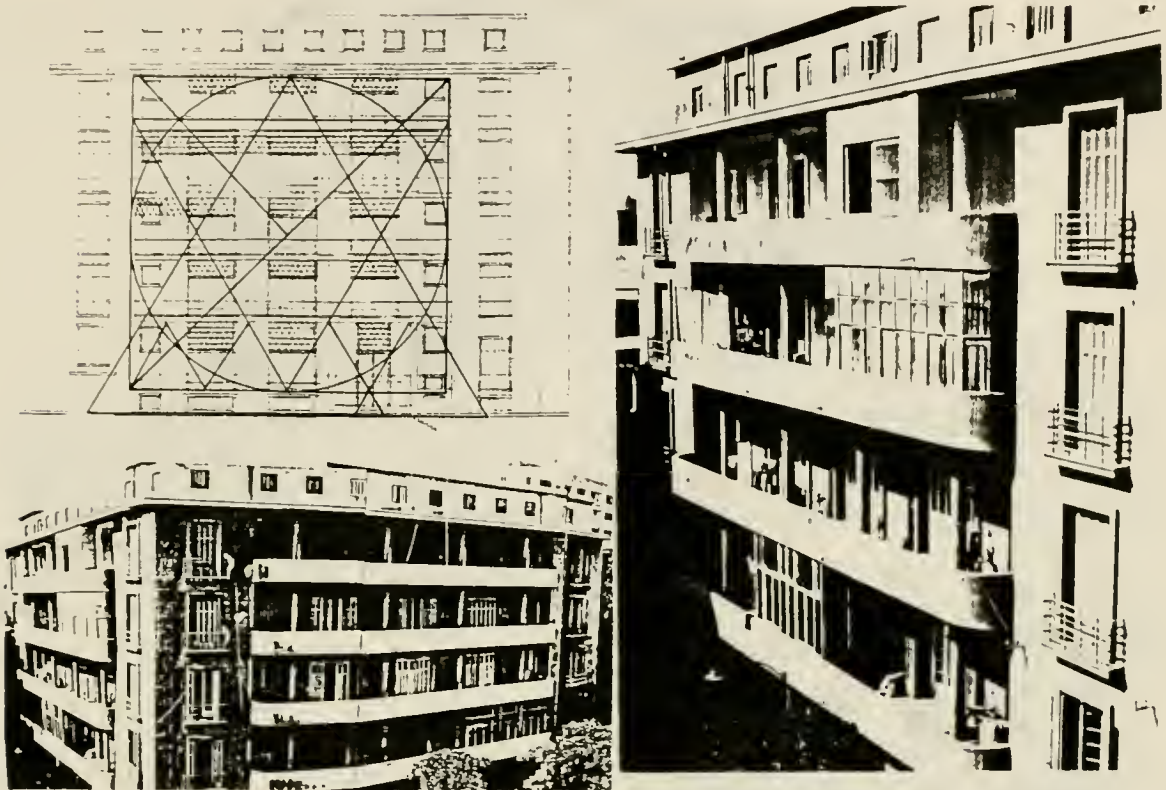
<sup>13</sup>Fanelli's date for this building is 1934-36





170-1932, *Project of the an office building and laboratory for the Mational Marine, Rue de Paris, Indret.*

171-1932-33, the construction of Louis Pasteur Hospital, William Vetter architect, Colmar, Haut-Rhin.



172-1932-33,<sup>14</sup> Immeuble de rapport Edouard Aghion, rue Pasteur (Lomboroso), rue Saurès, Alexandria, Egypt. (Fanelli, fig. 157; the author's own photographs)

173-1933, *Project of Jean Cartan sepulchral monument, Dolomieu .*

174-1933-34, *project for the Trocadéro and the general plan of 1937's exposition. Trocadéro. (see Champigneulle p. 101- 102)*

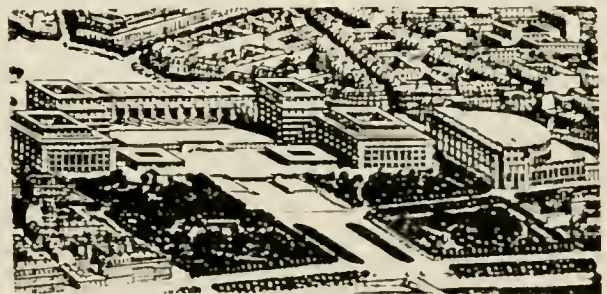
175-1933, *project for the Exposition de Marseille, Marseille.*

176-1933, *project of a Gouvernemental Palace. Algiers,Algeria.*

177-1933, *project of an Agricultural palace, Algiers,Algeria.*

178-1933, *project for the Extension of Metz port. Metz.*

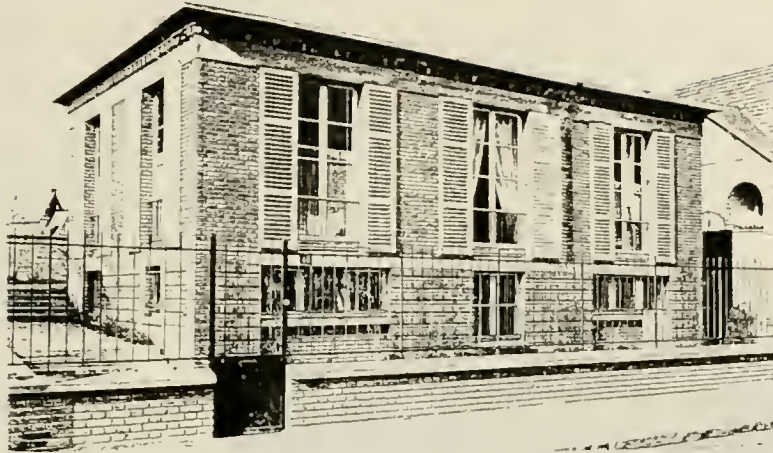
179-1933, *Project of general plan of the International Exposition of Arts and Techniques of the modern life , 1937., (Fanelli, fig. 196)*



<sup>14</sup>Fanelli states that Perret designed for Edoward Aghion two projects in 1932 and 1933. Although Fanelli provides two different addresses for the two designs (rue Lomboso, and rue Pasteur), I assume that both correspond to one site. For explanation see point 4.2.2



180-1934, Maison Paul Lefèvre, Sceaux.  
 181-1934, Garde-meuble National.



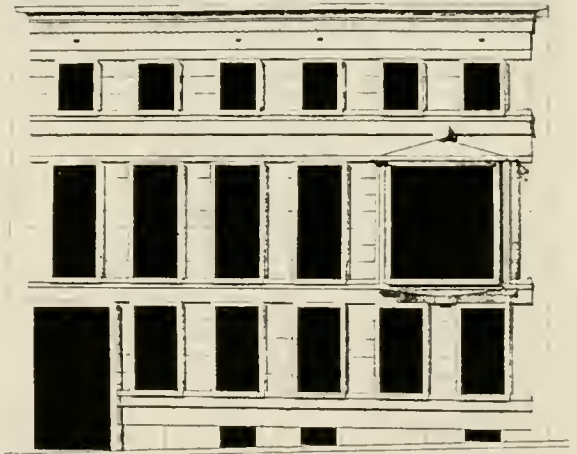
182-1934, Charles Mauduit House, 46 avenue Racine, Sceaux, Hauts-de-Seine. (Fanelli fig. 206)

183-1934, a laboratory, 48 rue de la Procession, Paris.

184-1934, General Hospital for the Public Assistance, Mustapha, Algeria.

185-1934, *Project of the immeuble de rapport at Henri Aghion property, Rue de Ramleh and rue d'Aboukir, Alexandria, Egypt.*

186-1934, *Project of a jardin d'hiver, Jardins des Plantes, 57 rue Cuvier, Paris.*



187-Vila Perigord, Avenue du Champ-de-Juillet, Limoges, Haute-Vienne. (Fanelli fig. 208)

188-1935, Pont de l'Arc.

189-1935, *Project of a bridge over Oued Serdoun, Chemain vicinal n. 4.*

190-1935, *Project of a monument, Route de Strasbourg, Lione.*

191-1935, *Project of a Pavillion at the M<sup>me</sup> Clacquesin property, Le Recoude, Marne.*

192-1936, Distribution office of the U.F.F., Boulevard de Flandre, rue de Picardie, Algeria.

193-1936, *Project of Presbytarian, 83 avenue de la République, Le Raincy, Seine-Saint-Denis.*

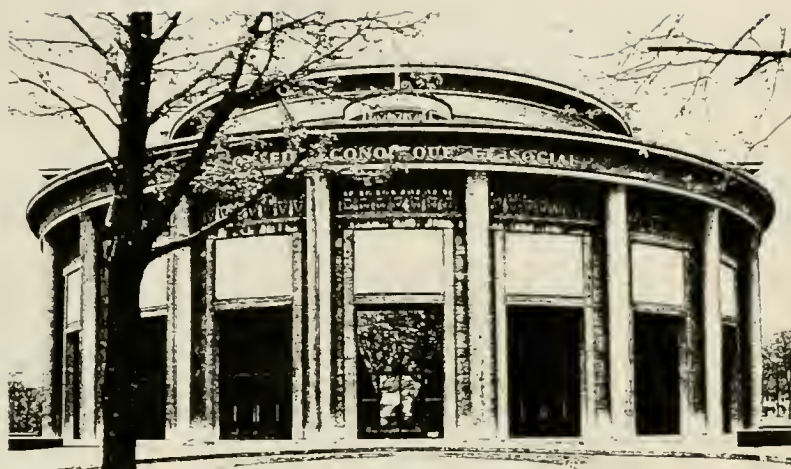
194-1936, the preparation of the French section, VI triennale of Milan.

195-1936, *project of a Pershing Monument, Route de Versaille.*

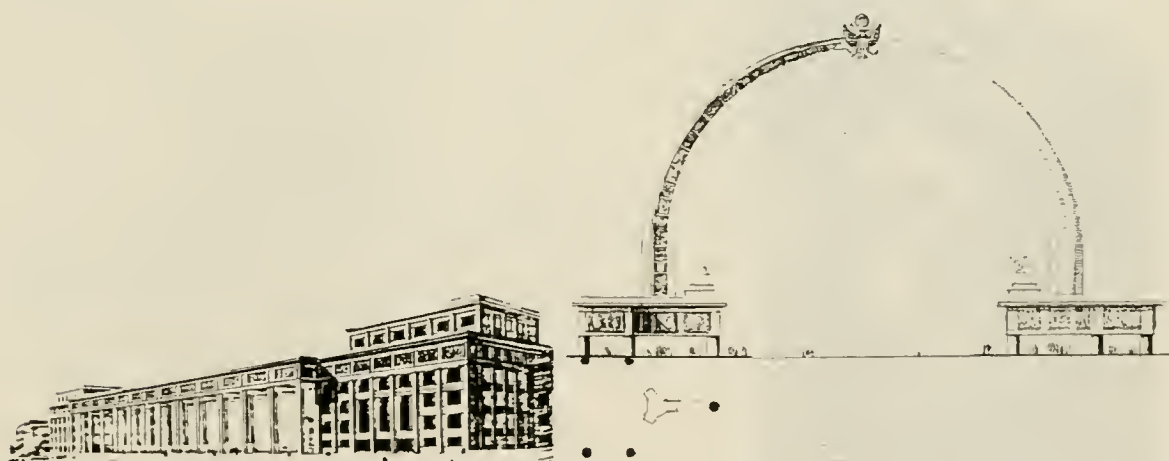
196-1936, the upgrading construction of the area of the boulevard Marechal-Roch, Jacques Giauchain and Maurice Rotival architects, boulevard Marechal-Roch, Algeria. (see Fanelli, fig. 223)







197-1937, Musée des Travaux Publics, Place d'Iéna, Paris. (see Champigneulle, p. 90-95. Fanelli 212-222)



198-1937, project for the Palais de Chaillot. (Champigneulle p. 102)

199-1937, a project presented in the competition of Genral John Joseph Pershing and the American army monument, Route Nationale 185, Butte-de-Picardie, near Versailles

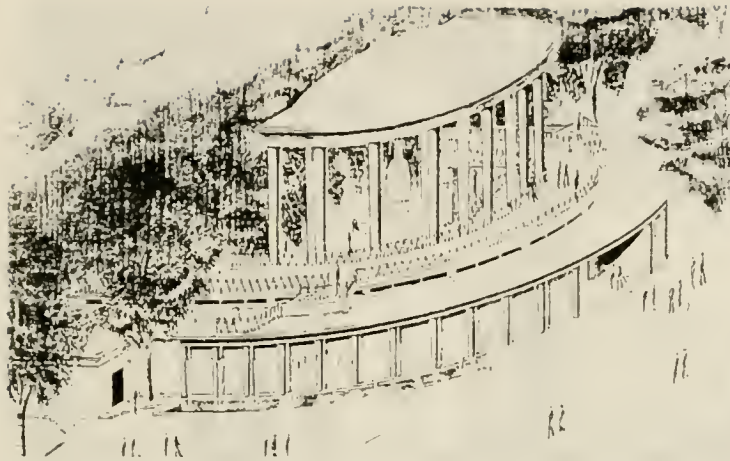
200-1937, Project of Lilian Holbrook Sepulchral monument, Neuilly -sur-Seine cemetery, Hauts-de-Seine.

201-1937, Project of Maret's hospital, Maret.

202-1937, the construction of the Algeria Pavillion, Jacques Guiauchain architect, at the International Exposition of arts and techniques of the modern life, Paris.







203-1937, Hygiène & Eau Pavillion; Public work ministry Pavillion; and project for Argentina Pavillion, at the International Exposition of arts and techniques of the modern life, Paris. (Fanelli fig. 224)

204-1937, a project of Paul lefevre house, Boulevard Gallieni, El Biar, Algeria.

205-1937, a project of a Theatrical Hall, 44-146 avenue des Champs-Elysées, Paris.

206-1937, a project of a laboratory, 16-18 rue Emerieau, Paris.

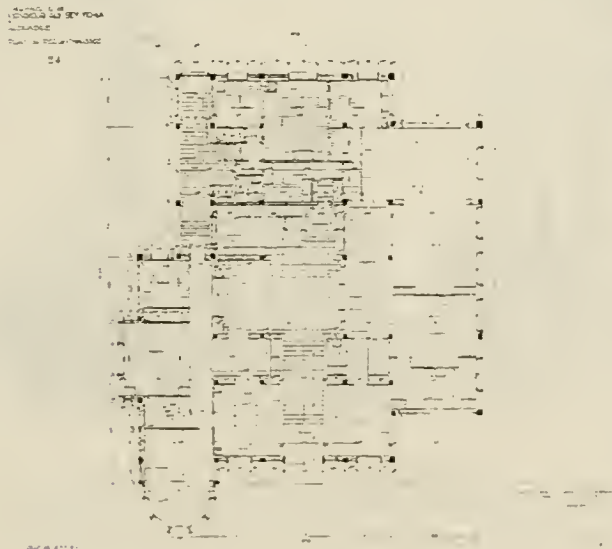
207-1937, a project of a school for the ministry of the marine, 8 boulevard Victor, Paris.

208-1937, a project of Canoine Cornette sepulchral monument.

209-1937-45, Saint-Charles factory, Eragny, Oise.

210-1938, a project for Bellonet villa, Molineuf. (see Fanelli fig. 225, 226)

211-1938, Pierre Barès book store, Avenue Friedland, Paris.



212-1938-39, Immeuble de rapport Aly Yehia Bey<sup>15</sup>, Alexandria, Egypt. (Fanelli, fig. 227; the author own photograph)

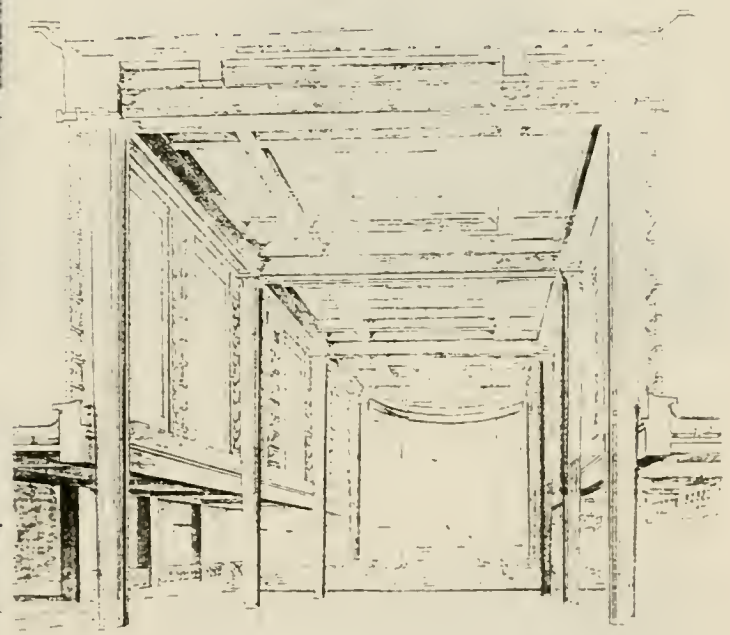
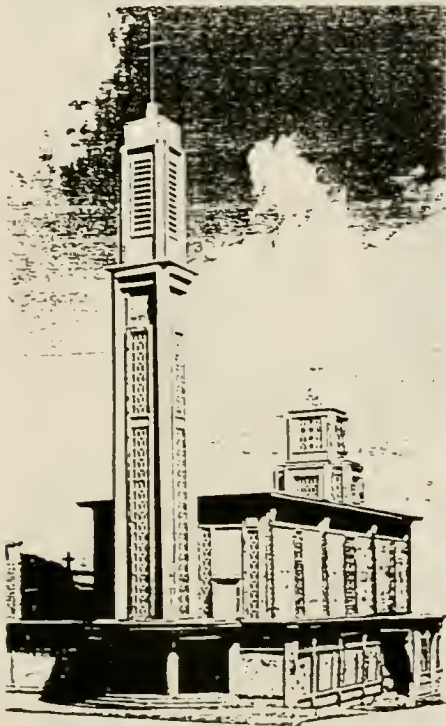
213-1939, Manufacture d'Horlogerie, 7 avenue de Montrapon, Besançon.

<sup>15</sup>Fanelli states that Perret's design was never executed. However, I assume that Aly Yehia's building exists in Alexandria, Egypt. See point 4.2.3.





214-1939, Usine in Issoire, Issoire, Puy-de-Dôme. (Fanelli fig 234, see also fig.235, and Champigneulle p. 107)



215-1939, Eglise de Saint-Benoît, Carmaux, Tarn.<sup>16</sup> (Champigneulle p. 105, Fanelli fig. 229)

216-1939, Deslandre laboratory, 73 rue Dutot, Paris.

217-1939, project for Nuestro Señor of the mercy chapel.

218-1939, Project of a residential building, 21 rue Desfontaines, Algeria.

219-1939, a shop at 83 rue Doudeauville, Paris.

220-1939, Project of a residential complex, Dabat property, Rue du Mont-Valérien, boulevard de Versailles, rue de Pierrier, Saint-Cloud, Hauts-de-Seine.

<sup>16</sup>Although Champigneulle published an exterior photograph of this Eglise, Fanelli incorrectly claims that Perret's project for this chapel never been erected.







221-1939, a project for Mostafa Kamal Atatürk Monument. Ankara, Turkey.  
(Champigneulle p. 106. Fanelli fig. 230)

222-1939, project of an apartments building, Ain Zeboudja park, El Biar, Algeria.  
(Fanelli, fig. 228)

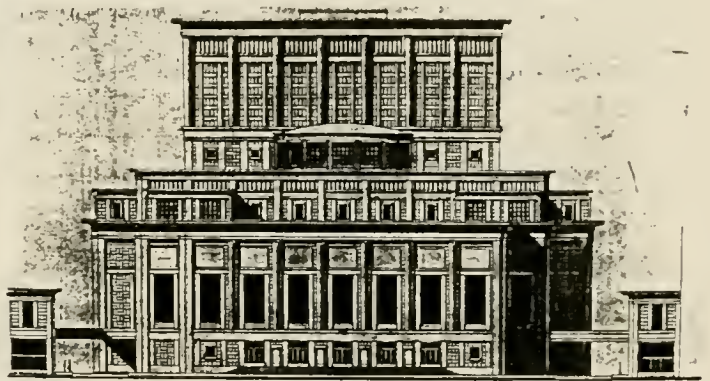
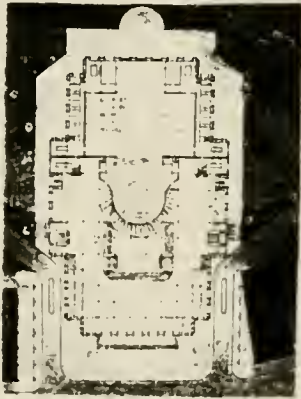
223-1940, Office for the Frères Perret, 51 rue Raymond, Boulogne-Billancourt, Hauts-de-Seine.

224-1940, the construction of a Girl secondary school, Marcel Cristofle architect, Constantine, Algeria.

225-1940, Gaz tank, Soyaux, Charente.

226-1940, a project for the Théâtre Comœdia. Istamboul, Turkey.

227-1940, a project of Laroche-Joubert paper mill, Mouveau Saint-Cybard.



228-1939-40, a project of a Grand Théâtre, stamboul, Turkey. (Fanelli fig 231, 232)

229-1940, project for Les Thermes de Paris.

230-1940, project for Les Champs-Élysées and Les Invalides.

231-1940, project for the Plaine de l'Arc, Berre, Marseille Aeroport.

232-1941, Chalet Aime Schmuck, Lac-ou-Villiers, Doubs.



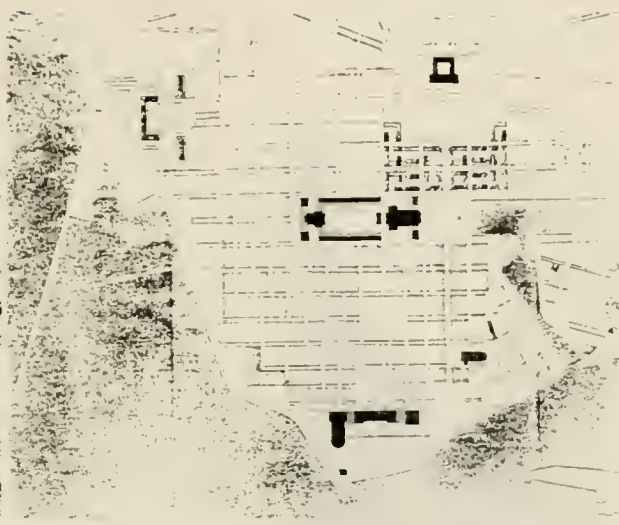
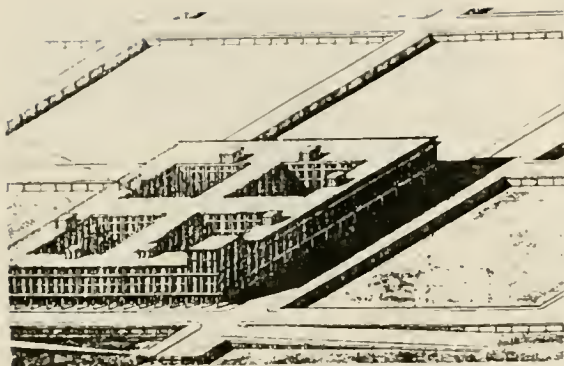
233-1941-43, Project for the reconstruction of the management office building of the Industries Navales, Toulone. (Fanelli fig. 236)

234-1942, Project of a Festival Hall, Carmaux.

235-1942, project of an office building for the Navigation management, Quai de Grenelle, Paris.







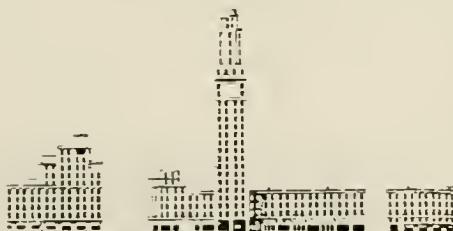
236-1945, Plan général du Havre, with the collaboration of the architects of the 'ateliers de Reconstruction de la ville de Havre', Le Havre. (Fanelli, fig. 253-265)

237-1946, Project of an office building for the Berny & Peignot foundry, 14 rue Cabanis, Paris.

238-1946, Project for Elias Atwad villa, Beni-Suef, Egypt.

239-1946, Project of Bally's shop, Boulevard de la Madeleine, Paris.

240-1946, Project for an office building, Beirut, Lebanon.



241-1947, Reconstruction of la place de la gare at Amiens. (Champigneulle p. 124; Rogers p. 165. Fanelli fig. 245-252)

242-1947, Project for a Hangar, with the collaboration of L. Coutry and L. Han, Dar el Baida, Algeria.

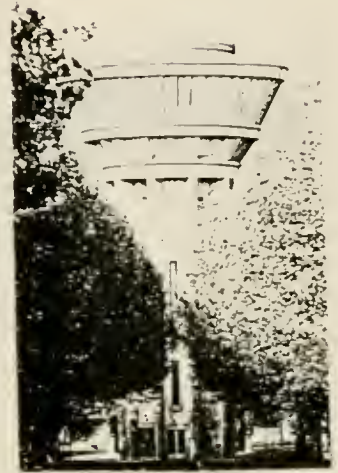
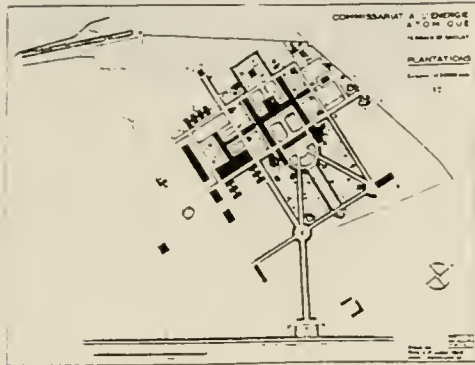
243-1947, Project for André Moch monument.

244-1947-48, Project for Marignane airport, near Marseille.



245-1947-49, *Project for a museum of Armando Alvares Penteado* Art, Rue Itapolis, Rue Alagoas, rue Itatiara, San Paulo.

246-1948, La Tour Perret, Amiens.



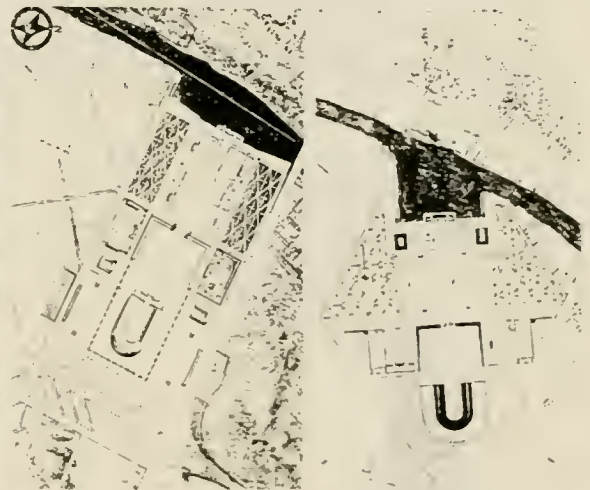
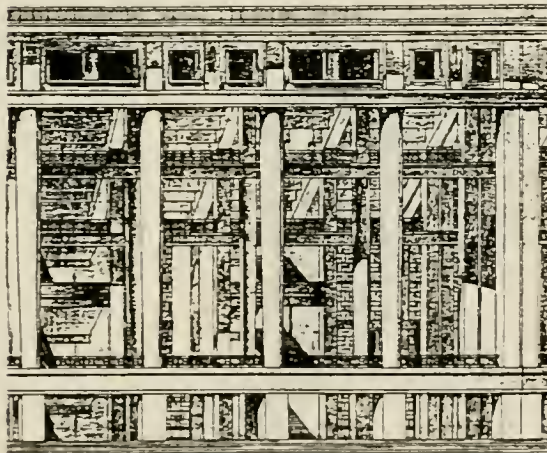
247-1948-53, General plan and the construction of the Commissariat à l'Énergie atomique, Saclay, Essone. (Fanelli fig. 241, 242, see also Champigneulle p. 126)

248-1948, Marcel Midy Laboratories (modified in 1972), 76 boulevard Bourdon, Neuilly-sur-Seine, Hauts-de-Seine.

249-1948, *Project of René Gosse Mausoleum*, Manival, Isère.

250-1948, *Project for the contemplation city* (with the collaboration of José Imbert), La Sainte-Baume.

251-1948, the construction of a Jetty for the harbour of Algeria, project by U. Cassan and J. Larras, Algeria.



252-1948, a project of a Stade Olympique, Montesson, near Paris. (Fanelli fig. 239, 240; Champigneulle p. 100)

253-1948-49, *Project for La Rochette factory*, 51 rue Constantinine, Venizel, Aisne.

254-1948-49, *Tour de souvenir*, project of a monument for the French soldiers of Brookwood, England.

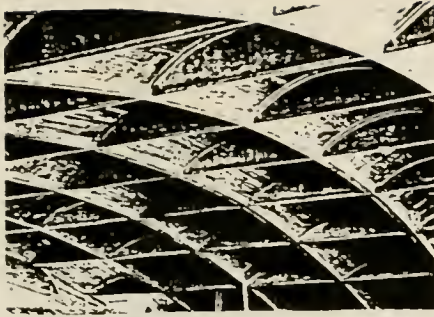
255-1949, *Project for a concert pavillion*, Place Coquillat, Algeria.

256-1949, *Project of a typical school* for the National Education Ministry.

257-1949, *project for Berre airport*, Berre.

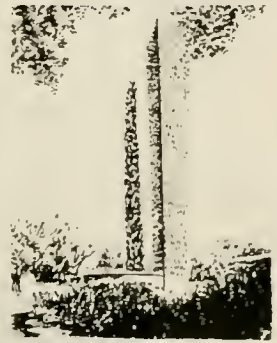






258-1949, Hangars for the Marignane airport (with the collaboration of Société des Entreprises Boussiron), Marignane, near Maerseille. (Champigneulle p. 123. Fanelli fig. 237)

259-1950, residential complex for the Commissariat à l'Energie Atomique, Gif-sur-Yvette, Essone.



260-1950-51, Project for a commemoration monument for Antoine de Saint-Exupéry, Saint-Raphaël, Var. (Fanelli fog. 278)

261-1951, Project of a garage, Faubourg Saint-Honoré.

262-1951, Project for a residential complex, Boulevard Wallace, rue de Longchamp, Bagatelle.

263-1951, the construction of studios and depot for the Ecole Nationale Supérieure des Beaux-Arts, J. Laurent and J.-L. Humbaire architects, 14 rue Bonaparte, Paris.

264-1951, Project for Robert Dodane villa, Morteau, Doubs.

265-1951, Project of an office for Route-Betrand Fils & Justin Dupont company, rue de la Voie des Bancs, rue du Truce, Argentine, Seine-et-Oise.



266-1952, Eglise Saint-Joseph. (with the collaboration of Raymond Audigier), Boulevard François 1<sup>er</sup>, Le Havre. (Fanelli fig. 269-270, see also fig. 271-277; Champigneulle p. 115)







267-1952, Hotel de Ville, Place de l'Hotel de Ville, Le Havre. Note the column Egyptianized detail. (Champigneulle p. 114. Fanelli fig. 266-268)

268-1952, Hangars, Marignante.

269-1952, Office building for S.N.E.C.M.A., Avenue Stalingrad, Paris.

270-1951-56, the reconstruction of Vieux Port district (with the collaboration of André Devin and Fernand Pouillon), Marseille.

271-1953, *Project of a chapel.*

272-1953, *project for Devaux house*, 20 rue des Graviers, Massy, Seine-et-Oise.



273-1953-55<sup>17</sup>, Immeuble Weill, 174-176 Boulevard Berthier. (Fanelli fig. 243)

274-\*1954, the construction of an Immeuble de rapport, Paul Branche architect, 16 avenue de Versailles, Paris.

<sup>17</sup>Fanelli's date for this building is 1951-52.



## Appendix II

### Reinforced Concrete: Analysis techniques



### Reinforced Concrete: Analysis Techniques

This list is a review of nondestructive testing techniques for reinforced concrete, stating their field use, their advantages and limitations. It should be noted that all the following nondestructive test methods could be done in situ. The tests involved in the determination of specific heat and the permeability of either gas or liquid are not included because they do not withstand the nondestructive nature.

Technique	Tests Involved	Use	Advantages	Limitations
Surface Hardness (Germany 1934)	Williams pistol, Frank spring, and Einbeck pendulum hammer	Estimation of concrete strength.	Short time testing. 20-30% accuracy.	Extreme care in the use of hammers not to destroy the surface. Removable of any surface finishing.
Rebound Method (Switzerland 1948)	Rebound hammer test (Schmidt rebound hammer)	Elastic rebound of concrete, estimation of concrete strength, flexural strength, modulus of elasticity, and comparative investigation	Inexpensive, simple and quick. Could be conducted horizontally, vertically upward or downward or at any intermediate angle.	Calibration procedures is difficult, since it depends on a chart. The result is affected by several surface factors.
Penetration Techniques	a-[Simbi hammer (1954), Spit pins (1954)] b-The Windsor probe (1964-66)	The penetration and pullout resistance of concrete, strength estimations, and comparative studies	b-Provides a quick means of checking quality of concrete in situ.	a- Affected by the arrangement of coarse aggregate. Damage the surface. b-Doubtful calibration . Should be calibrated according to each kind of aggregate. A destructive test leaving a hole.
Pullout Tests (USSR, 1934)		Pullout resistance of concrete, strength, and comparative studies	Evaluate concrete strength of the critical member of the structure. Easy and safe equipment.	Should be previously embedded. Damage of the surface. Doesn't investigate the core (3 in limit).
Dynamic or Vibration Methods	a-Resonant frequency (USA, 1938) b-mechanical sonic and ultrasonic pulse velocity methods (USA, 1945)	Durability and uniformity of concrete. Estimate strength, elastic properties, and Poisson's Ratio.	a-Excellent means to study deterioration of concrete specimens subjected to acidic and alkali attack b-In both the field and the laboratory. Relatively cheap and easy to operate. Recommended for quality control test.	a-Laboratory test. Skill and experience are needed. Small sized specimens. b-Require smooth surface of contact, and long path to avoid heterogeneity of concrete. Temperature should be 5 to 30°C. Concrete should be dry. Measurement should be taken away from the reinforcement bars.





<b>Technique</b>	<b>Tests Involved</b>	<b>Use</b>	<b>Advantages</b>	<b>Limitations</b>
Combined Methods	Ultrasonic pulse velocity and rebound hammer	Estimate the strength of the concrete	Simplicity of both techniques employed, can be used in situ.	Refer to the limitation of each test.
Radioactive Methods	x-ray (1949) and gamma-ray (1952) penetration tests,	Density and thickness of concrete. Location of reinforcement, honeycombing.	Easy to use in situ. Gamma rays are more portable than x-ray equipment.	Costly, dangerous high voltage equipment. Safety factors are also considered.
Nuclear Methods	The neutron scattering and neutron activation.	Moisture and cement content determination	In situ test.	Expensive and sophisticated. Could not be used with calcareous aggregates because calcium offers poor sensitivity to fast neutron activation
Magnetic Methods	Pachometer and cover meters	Determining cover or reinforcement to concrete	Give satisfactory results if members are lightly reinforced. Accurate (0.25 in accuracy)	In heavily reinforced section, the secondary reinforcement could not be eliminated. Calibrated to round steel bars only. Could not be operated below 32 F.
Electrical Methods	-Dielectric measurements -Electrical resistivity probes.	Measure moisture content and thickness of concrete.	Simple testing equipment and testing procedures. Cheap portable units.	Air entrapment, mix proportions, density, steel reinforcement have great effects on resistivity measurements. High-frequency currents are used.
Microwave Absorption Techniques		Measure moisture content and thickness of concrete		Equipment has to be developed.
Acoustic Emission Techniques		Study the initiation and growth of cracks in concrete.	Evaluation of loading levels. Monitor structural members to locate the origin of cracking and deterioration.	Very expensive equipment. It has to be developed. Readings are only during the period of increasing deformation and stress



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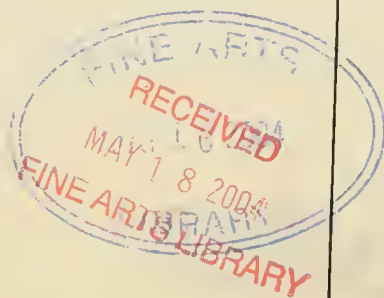


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